ARNOLD'S LECTURES

ON THE

STRUCTURE AND LAWS

OF THE

HUMAN BODY;

ADAPTED TO THE CAPACITY OF YOUTH:

DESIGNED AS A

TEXT-BOOK FOR SCHOOLS;

WITH QUESTIONS FOR EXAMINATION APPENDED.

BY

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CINCINNATI:
H. M. RULISON, QUEEN CITY PUBLISHING HOUSE,
115 MAIN STREET.
PHILADELPHIA:
DUANE RULISON, QUAKER CITY PUBLISHING HOUSE,
[illegible] SOUTH THIRD STREET.
1856.

E. MORGAN & SONS,
STEREOTYPERS, PRINTERS, AND BINDERS,
111 MAIN STREET.

PREFACE

TO

ANATOMY, PHYSIOLOGY, AND HYGIENE.

THE following Lectures on ANATOMY, PHYSIOLOGY, and HYGIENE were written to supply a deficiency which appeared to exist in our library of Common School text-books, and to supply a work on this most important subject that could be read with propriety and interest in every family circle. It has always appeared strange to the author that the subjects on which these lectures treat, should have been so neglected in our Common School education. None can deny that this knowledge should be familiar to every one. Just in proportion as health is to be desired and sickness to be avoided, is there a necessity of understanding thoroughly the structure and laws of one's own system.

One reason why this subject has not been studied more generally is, that proper text-books have not been afforded. Those written for this purpose have either been obscured by technical terms, or have been written in such a dry, uninteresting style as to discourage the student at the outset. I have, in the following lectures, endeavored to avoid these objections; to treat the subject in a plain, familiar manner suited to the capacity of youth, and have endeavored to illustrate the different subjects so as to make them interesting to the scholar as well as instructive. Whether I have succeeded in this endeavor, remains to be decided. If this little book shall have an influence in introducing the study of Physiology into our schools and families, it will have accomplished the earnest desire of its author. This subject

recommends itself not only to parents in behalf of their children, but to parents themselves. The truths contained in this book, I trust, will be found interesting and instructive to every one, to the father, the mother, the young gentleman, the young lady as well as to youth. Parents wish to bring up healthy families: how will they do it without a knowledge of the laws of health? The young man wishes to live a long and active life; a knowledge of life's laws are indispensable to him. The young lady wishes to be spirited, accomplished, and handsome. She will find Physiology to be the only true book of beauty.

Books on this subject should be found in every family; they should be studied in every school. More vigorous constitutions, longer lives, more physical and mental enjoyment, less sickness, fewer quack medicines, fewer and better doctors, would be some of the happy fruits.

It is earnestly recommended that all, both old and young, first study thoroughly this Part, treating of the human body in its *healthy* condition; then that they study as thoroughly the Second Part, treating of the body in an *unhealthy* condition, or of Disease, its Cause, Prevention, and Cure. A knowledge will thus be acquired that will be of more practical utility to its possessor than any other branch of human knowledge.

Every one, however busily engaged, can save time enough during six months or a year, to master this subject thoroughly. Go to, then, and study yourselves, that you may know the beauties and perfections of your own bodies—that you may enjoy life as it should be enjoyed, and that you may not be imposed on by the ignorant charlatan, who may not possess as much knowledge of his business as you may acquire by a careful perusal of these pages.

J. L. A.

JANUARY, 1856.

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ANATOMY,

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LECTURE I.

I AM about to deliver to you a course of lectures on PHYSIOLOGY; and I shall require your fixed, undivided attention, while addressing yoú on this subject, that you may understand and fix in your mind the truths I propose telling you.

Unless you commence with me on the start, with the determination of understanding and retaining everything as fast as it is said, it will not do you much good; no more than the superficial study of any other subject.

There is hardly a necessity of my telling you the utility of this study. If there be any subject necessary to be known to a human being, it is the subject of himself. The body is but a machine, worked according to fixed physical laws. We understand the most of these laws, and will at some future time, no doubt, understand all of them; so that every operation of the human body can be explained with as much certainty as the operations of a steam-engine. It will require no greater discoveries in science to bring this

about, than have already been made. You will admit that it is absolutely necessary for an engineer to understand thoroughly the structure, the workings, and the strength of his engine, in order to run it profitably and safely. Now, if the human body is a machine, and much more complicated than any other machine, how vitally important is it that its engineer, or mind, should understand as much as possible of its structure, its workings, and its strength? It would seem as though this knowledge of ourselves was of more importance than any other branch of knowledge that is commonly taught in our schools. It would seem that more of our happiness depended on this knowledge than on any other. Good health is the basis or foundation of all earthly enjoyment. With the unnatural customs and vitiated tastes of modern society, it is next to impossible for us to have good health without an actual knowledge of the physiology of the human system; so that we can avoid those habits that are injurious to our health.

The studies that have always had a preference in our schools, such as grammar, arithmetic, and the foreign languages are, in reality, of less importance to us than the study of physiology, because a knowledge of these branches is not essential to the possession of good health, while a knowledge of physiology is absolutely so. In the first periods of man's existence, this physiological knowledge was not so indispensable, for men lived more naturally then; their appetites and desires were instinctive and proper, not leading to disease and death, as the artificial appetites and desires of more modern times do. It was not the design of our Creator that we should be sick any more than the wild animal, that lives naturally in the forest, is sick.

Our bodies are constructed so as to keep in perfect order until they are actually worn out by the labors of the series of years allotted to man.

This improper way of living is one of the bad effects of our superior intelligence misdirected. Animals, in their natural state, not knowing how to devise unnatural habits, enjoy perfect health through their whole lives. You find no diseased livers, hearts, lungs, bowels, or even teeth, among them. I do not refer here to domesticated animals, for they are subjected, more or less, to artificial habits by man; and hence we find disease among domestic horses, cows, and sheep. I think I am safe in saying, that there is not one person in ten, among enlightened nations, who, at the age of thirty, has a perfectly sound and healthy body. This should not be so. We should enjoy as good health at sixty as at sixteen. A strict observance of the laws of physiology will enable us to do this, so that even our teeth shall remain sound to an extreme old age. Is not a knowledge of physiology, then, a thing to be desired above all other kinds of knowledge? And is it not worthy of a large share of your time and attention as a study?

The word Physiology is derived from two Greek words (φυσις, meaning Nature, and λογος, meaning a discourse). Physiology would literally mean a discourse or treatise on natural objects. This was the province of physiology in the early history of the natural sciences, when less was known of all of them than is now known of the most insignificant of them. More latterly, however, the bounds of physiology have been restricted to a study of the functions or

uses of the different parts of organized things, either of the animal or vegetable kingdom.

Here I might as well define what I mean by an organized body, inasmuch as the term will occur frequently in these lectures.

An organized body is one that has life; that grows from nutriment taken from the external world by a set of vessels going through its internal structure, which vessels assimilate this nutriment to the different structures of the organized body. An organized body dies and undergoes decomposition, or a separation of its component parts. All organized bodies originate from a germ, or seed. The animal and the vegetable kingdoms are the province of organized bodies, while the mineral kingdom is the province of unorganized bodies. A horse is an organized body, so is an apple-tree or a blade of grass, because they have life and grow by means of nutrient vessels; but a stone is an inorganized body, because it has no life, and its only way of increasing in size is by external accretion, or an adding on to its external surface.

As easy as it may seem to distinguish between an organized and an inorganized body, there are some instances in which it is difficult. It is difficult to distinguish the mosses and many other plants of the lowest order in the vegetable kingdom, from the rocks on which they grow. In the Mississippi valley, above New Orleans, are whole forests covered with a drapery of moss, appearing as though the trees had been dipped in a huge tow-heap to supply the spinning-wheel of some giantess. One would hardly believe that there was life in this moss; but it lives and grows, the same as our bodies do, by nourishment.

The sponge is a vegetable, and so is the mould that grows on the barrels in our cellars.

Some plants grow, when suspended in the air, with no other nourishment than what they absorb from the atmosphere. The leather-tree of South America, is found on the most sterile rocks, from which it seems incredible that nourishment could be derived. To the sight it exhibits no signs of life, yet it lives and grows. More difficult still is it to draw the line of demarcation between the vegetable and animal kingdoms—to tell precisely where the one ends and the other commences. There are some vegetables that appear to have sensation and locomotion, while there are some animals that can scarcely be said to have either. The sensitive plant contracts instantly on being touched with the hand. The fly-trap, a plant of South America, shuts its spiked leaves when an insect gets in them, and holds it fast.

There is a kind of water-plant that separates itself from the stalk, and floats in search of the opposite sex. On the other hand, the zoophytes, which produce coral, forming immense reefs and islands in some parts of the world, are but a degree removed from the vegetable kingdom.

There are some kinds of worms that appear to have no sensation whatever, nor digestive organs, being nourished by absorption through the skin. There are others—as the tapeworm—that increase their species by throwing off joints, like the prickly pear, each severed joint growing of itself, like the parent body. There are organized bodies found in the human body, worms for instance, whose precise origin and nature are not even now known. The chrysalis, or form that silkworms and others of that kind assume, is as near

the nature of a vegetable seed as can be, awaiting but for favorable circumstances to germinate and grow.

Eggs of animals are nearly allied to the seeds of plants. As we ascend the scale of life, we find it hardly perceptible in the lowest orders of plants, becoming more and more developed as the higher orders of vegetables approach in organization, the lower orders of animals. Ascending from the lowest orders of animals, we find that the earth-worm has more life than the oyster; the moth more than the worm; insects and serpents more than moths; fish more than insects and serpents; birds, more than fish. The mammalia (or sucking animals.) have a higher organization, and consequently more life than birds.

Man stands at the top of the scale. He has the most perfect organization, and consequently is superior to all other animals. Man differs from the other mammalia in these respects: First, in his erect posture. No other mammalia walks, habitually, in an erect posture. The simia, or monkey tribe, approaches nearest to man in this respect; and some so called progressive philosophers, have gone so far as to say, that man was originally a monkey, and by gradual improvement, became man, in the same manner that the original crab-apple has, by cultivation, become the delicious pippin and rambo of the present day. Some wag has appended to this supposition, that men were originally monkeys—the necessary explanation, that they wore their tails off by sitting on them. There certainly is at the present time, a marked difference between a man and a monkey. The monkey's arms are much longer than man's. It is unable to oppose the thumb against the fingers of the same hand, as in grasping an object. Its legs, or more properly, its hind legs,

are not articulated with the foot in a manner to admit of an erect posture; consequently it is with an effort, that it walks erect; its natural way of walking being on all-fours. The construction of its feet, and so called hands, is adapted to climbing. And here I will remark, that in the study of physiology, we shall find each organ of the animal economy perfectly constructed, so as to perform the function for which it was designed. We shall find that the animals designed to live on grass, (called herbivorous,) are provided with teeth suitable for cutting off the grass, and other teeth for grinding it; and with capacious stomachs for the digestion of such bulky food. We shall find that the animals designed to live on flesh, (called carnivorous,) are provided with teeth and claws, suitable for seizing and tearing their prey, and with small stomachs, suitable for digesting flesh. So perfectly is every organ constructed for the wants of the animal, that an experienced anatomist can describe the size, shape and nature of any animal on being shown a single bone that belongs to it. In this manner Cuvier, a great French anatomist, has given a description of many animals whose species have been extinct for thousands of years, having in some instances but a single petrified bone to make out the animal from.

There is another animal bearing some resemblance to man in its attitude and domestic relations—it is the penguin. The penguin is a water-fowl of the South Sea islands. When walking, it is nearly erect: a party of them appearing at a distance like a body of diminutive, corpulent soldiers. The penguin associates with another water-fowl, called the albatross. In the spring, which commences in that part of the world the first of October, hundreds of these fowls of each

kind, come together in a convention. After they have had their meeting, (I don't know whether it is presided over by a president and vice-president or not,) they select a piece of ground containing about four or five acres, bordering on the sea. They then go to work and clear it of sticks and stones, until it is as smooth as the most beautiful park. They then make a wall around it, except on the sea-side, and lay it off into squares. At the corner of each square sits an albatross; in the center, a penguin. As much regularity is observed in their organized cities as in a well-conducted military station. But the penguin, though able to walk erect, and possessing some intelligence, has no hands. It must use its neck and bill for all its, not manual, but cervical operations; which necessity would detract materially from man's superiority over the lower animals.

There have been some philosophers so absurd as to contend that man, originally, went on all-fours, but by education, he assumed an erect attitude. The structure of his body alone, would refute such a supposition. His lower limbs are much larger than his upper, showing that they are to support and carry his body. The bones of his spine (constituting his backbone,) are largest at the lower part of the spine, decreasing regularly towards the top, which is not the case in animals that go on all-fours. The shape of the spine, as a whole, is that of a small *f*, bending forward at the bottom, where the bowels do not occupy much room; then it curves backward to allow room for the lungs; then forward again in the neck. Now, a straight line drawn down through its curves, will fall within the base of the feet, showing the body to be perfectly balanced when in an erect posture.

His legs are set perpendicularly on his feet, and can be of use for walking in no other than an erect position. His hand is not constructed to support weight in the manner of a foot. In fact, the idea of walking originally on his hands and feet is too absurd to demand a serious consideration. And, beside, we see that a child, at the proper age, as instinctively tries to walk on his two legs as a colt does on his four. Man has more brain, in proportion to his nerves of sensation, than any other animal. There are some small birds that have more brain, in proportion to the size of the body, than man; but the most of their brain belongs to the nerves of sensation, leaving that part of the brain, in which is seated the intellect, in smaller proportion than in man. In intellect alone has man a superiority over all other animals. The elephant, the tiger, the horse, and many other animals are his superiors in physical strength. The birds have the advantage over him in flying; the fish in swimming; most of the animals in fleetness; many in seeing; many in smelling. But man's intellect alone compensates, aye, more than compensates for a want of superiority in any one or all of these. It enables him to harness the elephant to his chariot, and to make the lion and the tiger his servants. It renders superior physical endowments unnecessary, by enabling him to turn those of the inferior animals to his own use. Man, with no more intellect than the lower animals, would be the most defenseless of them. Birds have wings to fly from danger. Some animals are constructed for climbing from danger; others for fleeing it. Some hide themselves in the bowels of the earth, or in the depths of the sea. Most all have some defensive part, as horns, teeth, claws, trunks or stings.

All have an instinct for avoiding danger. Man has none of these: neither the physical advantages of the bird, the fish, the fleet animal, nor of the beast of prey; yet, he is master of them all.

Man differs from the other animals in his articulating or talking powers. This difference is but the result of his superior intellect. His organs for the production of sound are not more delicately formed than those of some singing birds. The mocking-bird, that approaches the nearest to man in this respect, cannot make a thousandth part of the combinations of sounds that man can. The shape and structure of man's head is peculiar to himself. The forehead is prominent, symmetrical, and round; affording a large space for intellectual brain. His eyes are so situated that he can direct the gaze of both on the same object, at the same time. This double power of vision, and the extensive revolution of the eyeballs, together with the facility with which the head moves on the bones of the neck, render his powers of vision extensive and peculiar. Man's jaws and teeth are different from those of any other animal. His jaws are smaller and less protuberant, calculated for crushing gently, substances thrust into the mouth. His teeth are such as belong neither to herbivorous nor carnivorous animals. He has neither canine teeth, like those of the dog, nor grinders, like those of the cow—showing that his food should not be raw flesh, nor unground grain, nor uncooked vegetables, but should be of a mixed nature, and cooked.

RACES OF MEN.

Most all physiological writers divide men into races, differing in certain characteristics of manners, color, and features. The differences of the races are

not sufficient to indicate a difference of origin. All the races of men, unquestionably, originated from the same parents. But by peculiarity of individual constitution, climate, and education, these characteristics of different races have been produced.

The following division of men into races seems to be best:

The Caucasian, Mongolian, American, Ethiopian, and Australian. The Caucasian is called thus from its supposed origin in the Caucasian mountains in Asia. A beautiful and hardy race still inhabits these mountains. For many years the immense power of Russia has tried in vain to subjugate these mountaineers. And now, under Shamyl, their chieftain, they are making head against their oppressors with greater success than ever. When men will sell their offspring to buy arms to fight their enemies with, as the modern Caucasians do, they may be said to be a desperate race.

The Caucasian women have been renowned from time immemorial for their great beauty. The rich Turks get their wives and concubines mostly from this region. They pay, not unfrequently, the most enormous prices for these brilliant gems of humanity to adorn their harems with. It is rather a melancholy reflection that beings, designed to adorn the highest situations in life, should be thus thrust into its lowest and most degrading depths, there to decay in obscurity in a living tomb, merely to gratify the animal passions of beings more brute than human.

The Caucasian race is remarkable not only for personal beauty, but for superiority in most other human endowments. It holds the sway of empire, of learning, and of benevolence. It is fast bringing under the

mild influence of its government and habits all the other races. At some future age the other races may become so mixed and assimilated with it, as to incorporate all races into one again. The wonderful mixing of different nations together, of late, by means of the increased facilities for emigration, seems to indicate this.

The head of the Caucasian is round and symmetrical. The forehead is prominent. The features and the whole body rounded, regular, and beautiful. The eyes large and prominent. The nose elevated. The complexion fair. The white inhabitants of the United States are of the Caucasian race.

The Mongolian race is characterized by a dark, olive complexion, prominent cheek bones, oblique eyebrows, flat visage, and scanty beard. It has existed from time immemorial in great empires, isolated, as it were, from the rest of the world. Hence it has retained its peculiarities with greater tenacity than any other race. Tartary, China, India, and Persia are peopled by this race. It is not so enterprising as the Caucasian nor so apathetic as the Ethiopian. It seems to have acquired a certain advancement in human knowledge and improvement, and there to have remained stationary for centuries. Alexander, over two thousand years ago, found India in much the same condition as the British found it not a hundred years ago.

China is a standing example of non-advancement and tenacity of old customs. The system of castes, that prevails in most all Mongolian nations, effectually prevents by its leaden influence any individual, consequently any national, advancement.

The American race consists of the different tribes

of American Indians, that now inhabit and that have inhabited the western hemisphere. This race is characterized by a straight, commanding form, copper complexion, straight, black hair, and high cheek-bones. It is of a roving, warlike disposition; subsisting principally by hunting and fishing. This race has furnished two nations somewhat advanced in the arts of civilization — the Mexican and Peruvian nations. They cultivated the arts of husbandry, architecture, and war to a great degree of perfection.

The negro or Ethiopian is characterized by woolly hair, retreating forehead, protuberant jaws, thick lips, and a black complexion. It has for many centuries been under subjection, to a great extent, to the other races.

The fifth division of the human family, the Australian, can hardly be considered a distinct race of itself, but more properly a degeneration of the Mongolian race, from which it probably had its origin. The East India and Australian islands are inhabited by this race. These islanders, together with the Polynesians, are perhaps the most degenerate of the human family.

These five divisions are sufficient under which to classify the marked peculiarities of men. Some writers have many more divisions, but if we should have as many divisions as there are peculiarities, we should have a race for every individual; for there never were two individuals with the same peculiarities.

A great deal of importance was formerly attached to another division of men into temperaments; as the sanguineous, lymphatic, choleric, melancholic, and nervous. Not so much importance is now attached to them.

We come now to examine man as an individual, and we shall find that the poet Young, speaks truly when he says,

> "How poor, how rich, how abject, how august,
> How complicate, how wonderful is man!"

Man may be said to consist of three parts — his mental part, his moral part, and his corporeal part. All these are intimately connected, so as to work harmoniously together as one complicated machine, if all the parts are in order; but if one wheel is worn away, or is broken, or runs faster or slower than the others, confusion and destruction is the consequence.

It is our object in these lectures to study these different parts; to learn the nature and the laws pertaining to the individual parts and those mutually relating to all, so that we may better understand how to direct this engine, we being constituted engineers of — ourselves.

It would be rather hazardous for a man to go on board a steamboat and begin to fire up, without knowing which screw to turn to let off steam when it gets too high; or to undertake to drive the boat ahead without knowing the channel. No less hazardous is it for one to go round on the top of his own individual engine, or rather his two-paddled steamboat, without knowing the nature and operation of its machinery. His knowledge of life-navigation requires to be pretty good to conduct his frail bark safely down the life-river, among its rocks and snags, having to wood with all kinds of fuel, and having to lay up at all sorts of landings.

A knowledge of ourselves is more important to our well-being than all other kinds of knowledge. In this self-knowledge we are not, as a general thing,

superior to the inferior animals. For each animal knows itself, its powers, its business, its wants, and the best means for supplying them. This cannot be said of all of our species. I think I am safe in saying, that there is not one man in three, even in this enlightened country, that finds out what he is, and what he is made for, until it is too late for the knowledge to do him any good. The beaver knows instinctively, that it has a trowel in its tail and an ax in its teeth. It knows from infancy how to use them to the best advantage. Further knowledge would avail it nothing; perhaps be an injury to it, by inducing it to attempt projects it was by nature unfitted to accomplish. With man, it is different; his self-knowledge must be acquired. But in man, this acquisition is unlimited, and the more he acquires, the more powerful he becomes. How essential then, to know himself thoroughly—the full extent of his powers, so that he can wield them to the best advantage.

We shall begin with the groundwork of man, his corporeal part—his body. We should form a very inaccurate idea of even the external appearance of our own species, if we never had seen but the parts which modern fashion permits to be seen. We should suppose, commencing at the feet, that the male sex walked on feet something the shape of a shingle hook, judging from the shape of a fashionable boot, we should imagine, that the ankle was as large as the upper part of the leg; that the chest was an inflated balloon, and that the head extended some foot or foot and a half above the crown. We should judge that the face of the male had nothing to distinguish it from that of the female. In short, we could not form a correct idea of a single part of the entire animal. Everything is

covered up but the face, and that even, is disfigured by the process of shaving.

If we could not get a correct idea of the external appearance of the male sex, by ordinary observation, the case would be worse with the female. We should suppose, judging from external appearances, that she was constructed something on the principle of the mermaid; the upper part human, and the lower part, not exactly fish-like, but cask-like. We should judge that she got along by means of a couple of little wings, fastened to the back part of the neck. We could however, form a pretty correct idea of her face, as she generally wears that in a natural condition, although it is not always the case; for in Oriental countries she has her face concealed by a veil, and in our own country, not unfrequently, by red and white powders. I should not be surprised, if it should become fashionable eventually, for us all to wear masks and goggles, it being immodest to expose the whites of the eyes or the tip of the nose. Our fashionable ballad screamers even now have to wear white gloves to sing in.

Whether this bandaging of the whole system, as if to cure it of one universal swelling, be right, be healthful, or natural, we shall hereafter inquire.

The human body is divided, by physiologists, into the head, the trunk, the upper and lower extremities. Viewing the body as a whole, we find it erect, symmetrical in its proportions, every part corresponding perfectly with the other, and so constructed as to be best adapted to strength and agility. We find no part of the human body in which we could suggest an improvement to suit our ideas of the useful or the beautiful. The lower extremities are the largest, because

they are to support the whole superstructure. The feet are made for stability and quickness of motion. The legs, for protracted support. The lower part of the body, for containing the bowels or furnaces of life, where the power is generated. The upper part, for containing the bellows to afford the necessary supply of air, without which, the internal fires could not be kept up. The mouth and throat are best constructed to prepare and furnish a passage for the air and fuel to their destination. The arms are placed at the side for guarding, loading and unloading, and otherwise serving the craft; while the head or pilot-house is placed on the top, or the hurricane-deck, where it can best command a view of the course, and of the whole environment of man. To be sure, it does not have windows on all sides like most pilot-houses, but what is better, it is fixed on a pivot, so as to revolve, and thus command a view in every direction. The body of man is furrowed all over by muscles. His limbs are principally made up of bone and muscle, not containing much fat; while the limbs of the female contain a greater proportion, which gives them a large, smooth, and rounded appearance; scarcely a muscle can be distinguished in a healthy female, not given to too much bodily labor. The skin of the female is also of a finer texture than that of the male. The hips of the female are broader than those of the male, which makes her waist appear smaller than it actually is. This broadness of the hips is peculiarly feminine; hence the reason why in all ages, artificial means have been used to render this peculiarity more striking. At one time hoops were used for this purpose—at another, quilted and sea-grass petticoats—at another, something in the shape of a life-preserver. The

female differs from the male, in having no beard, although coarse, masculine and strong-minded women are apt to have the vestige of one. Barnum has a woman, now on exhibition, in New York, who has a Simon-pure beard. Much, however, in relation to these sexual peculiarities, depends on the occupation. Let a man live the sedentary, unexposed life of most women, and he will become effeminate. Let a female work in the open fields and accustom herself to masculine exercises, and her appearance will become masculine. We frequently see lady-like gentlemen, and gentlemen-like ladies.

We will now study the different parts of the body in detail. The Skin first presents itself, covering almost the entire body. What parts are not covered by skin, are by mucous membrane, or nails or enamel, so that no part is exposed to the direct action of the air.

LECTURE II.

THE SKIN.

The skin is composed of three coats: the Cuticle, the Rete-mucosum, and the Cutis vera, or true skin. The cuticle, or outer coat, is transparent and devoid of sensation. It is designed as a protection to the more delicate parts beneath. It is made so as to increase in thickness and hardness, in proportion to the friction and pressure to which it is exposed.

Where the friction and pressure are great and constant, as in the case of those who labor continually with the hands, it thickens so as to form callouses. If it were not for this wise provision, men could not work long at any one kind of work. It makes no difference in what part of the body the friction is applied, thickening of the cuticle immediately takes place. The inside of the blacksmith's right-hand becomes calloused, so that he can hammer all day without inconvenience. The skin on the top of the head and on the shoulders, becomes callous, so as to enable porters to carry heavy weights there ten-times the distance they could before they had hardened the parts by use. In some occupations, the inside of the hands becomes almost like horn, without which quality it would be impossible for the laborers to pursue their calling. The person who goes much barefooted, has soles almost as impenetrable as tanned leather. The cuticle is like the outer bark of a tree, being insensible, designed for protection,

and is shed off continually. We see in this, as in every other physiological fact, the hand of an all-wise Creator, who has made provision in his works for all their wants.

The second layer of the skin is the rete-mucosum, which means a soft net-work. This layer is so thin and so easily torn, that it is with difficulty separated from the other layers. In this layer, resides the coloring matter of the skin, of the whole individual, indeed. The difference of the coloring matter in this insignificant film distinguishes the transcendent Caucasian beauty from the unnoticed squaw; and the noble American citizen from the miserable slave. The old adage, "that beauty lies but skin-deep," is too favorable, for it lies but half skin-deep. In Albinoes, this coloring matter is entirely wanting. Albinoes are persons with a very light complexion, white hair and colorless eyes, or rather red eyes: the want of coloring matter in the eyes, permitting the blood-vessels to be seen, which gives the eyes a reddish appearance. Albinoes cannot endure a bright light, because all the rays of light strike on the nerve of the eye, without the superfluous rays being absorbed by the coloring matter that exists in others' eyes. They can see by twilight or moonlight only. Albinoes are said to be more frequent in Central America than in any other part of the globe. Families of Albinoes have been exhibited through the United States as curiosities. One called the "White Negro Family," was exhibited about twenty years ago. "White negroes" and "white blackberries" seem to be a contradiction in terms, nevertheless both these things exist. You will notice, generally, a correspondence in color between the skin, hair and eyes. If one be

light-colored, the others will be also; if dark, the others will be dark. There are exceptions to this to be sure. We sometimes see dark hair above light-colored eyes. We sometimes see a fair complexion associated with dark hair and eyes. I have seen a tuft of light hair growing in the middle of a head of black hair. The color of the hair of the head and the beard also, generally correspond, though not always, to the great vexation of those gentlemen who would raise a black imperial or moustache; though the hair on their heads is black enough, their whiskers will persist in coming out red. These differences in color, like ball-eyed horses and dogs, with one light eye and one dark one, are but exceptions to the general rule. I don't know as this general complexion of the hair, eyes and skin has any influence on the health of individuals, but I have observed that those of a light complexion retain the freshness of youth much longer than those of a dark complexion. There is a certain description of persons, characterized by fair skin, round, full form, blue eyes and light hair, which seems to wear, or "hold its own," as the saying is, better than any other. This description of persons looks well to the very last.

The third coat of the skin is called the cutis vera, or true skin, because its functions seem to be more important than those of the other layers. It is composed principally, of bloodvessels, nerves and perspiratory ducts. In this, are situated the roots of the hair. This is the part of the skin that has feeling. We can stick a pin through the other two coats of the skin without feeling it, or without drawing blood, for you do not come to the nerves and bloodvessels of the

skin till you come to the third coat. This is the coat that is exposed in blisters and burns, when the "skin comes off," as the saying is. This is the seat of cutaneous diseases, or diseases of the skin, such as measles, scarlet fever, erysipelas, small-pox and the like. It is the seat also of two of the most important functions of the human system—absorption and perspiration; these two functions being performed by a distinct set of minute vessels opening on the skin, and connecting with the bloodvessels. These minute vessels are called the Perspiratory Ducts, and their openings upon the surface of the cuticle, are called the Pores of the Skin. This function of perspiration, or sweating, is an all-important one in the human system. It enables the body to preserve the same degree of heat in all temperatures. When fluid of any kind evaporates, it takes a certain quantity of heat—one thousand degrees—to convert it from fluid to vapor. In this manner, the part on which the fluid lies is cooled just in proportion to the rapidity of the evaporation. You dip your hand in water of the same temperature as your hand, and hold it in the air, it will suddenly become cold. This coldness is produced by the quantity of heat the water takes from the hand to convert the water into vapor. When the body becomes too hot, either from great exertion, or from too high a temperature of the surrounding air, the watery part of the blood is poured out through the perspiratory ducts and pores, on the skin, forming sweat or perspiration. By the evaporation of this perspiration, taking a thousand degrees of heat, the temperature of the body is kept the same all the time. If it were not for this provision, our flesh would melt

in the summer time, the same as a piece of pork when put out in the hot sun. This provision enables a man to sit in a hot oven until a piece of beef is baked.

Another use of perspiration is to carry off the fluids of the system when they are taken in too great quantity. It undoubtedly purifies the blood also by carrying off the useless and injurious matters that get into it.

How essential to our well-being it is then, that the skin be kept in a condition that it can perform properly its functions? How is this to be done, you ask? The medicine-vender steps up, bottle in hand, and says, "Take a tablespoonful of this syrup, three times a day; it will keep the pores of the skin open, and no mistake: price only twenty-five cents!" The advocate of individual rights says, that a hot stew, with a little good brandy in — the more brandy the better — is a sovereign thing to regulate this matter; no difference whether you sweat too much or too little. Old Granny Wormwood says, "Make a tea of catnip, sassafras, and rangumroot, and drink a quart every two hours." The Thompsonian advises that, if the pores won't keep open any other way, to steam them once in a while, and then they are bound to come open.

Hygeia, the goddess of health, intimates a more simple and natural way of keeping the skin in a healthy condition, and that is simply by keeping the skin clean, and keeping it clothed in such a manner as to prevent its being exposed to sudden changes of temperature. Either uncleanliness or sudden and prolonged exposure to cold will check perspiration. There is no necessity of your making an ice-breaker of yourself, floundering round in a millpond, every morning before breakfast,

during the winter months; or of living a fish-life in any other way, because we have neither the skin of the catfish nor the scales of the sheep's-head to enable us to live in this element.

We must always bear in mind that the skin, as well as every other organ, is capable of performing its duty itself, without any assistance, if it only has a chance. All that it is necessary to do then, is to keep it clean. The parts exposed to the air, the face, neck, ears, and hands, should be washed, as they generally are, three times a day; the feet, every night. Once a week, during the winter, the whole body should be washed, and once a day in summer. The best time to wash the body is just before going to bed; it calms down the nervous system and leaves it in a condition most congenial to sleep. The water for washing the body, should feel cool to the touch, but not cold enough to produce too great a shock. A strong, hearty person can bear the water colder than one in ill condition.

If a bath is used, after coming out of it, the body should be dried by wrapping a sheet around it, and then it should be rubbed with a towel. Bathing should be conducted so that the skin will experience a lively sensation after the process. There is no excuse for any one neglecting this. If a bath is not at hand, take a basin or pail and a towel, and make a business of it at regular times. Even if your system derived no permanent good from it, the delicious sensation one feels after bathing, is sufficient compensation for the trouble. But don't run into the other extreme of bathing much oftener than here recommended; that is, using bathing and rubbing as a

stimulus to excite the skin to an inordinate action. This practice is but another form of intemperance. It is not a whit better than stimulating the stomach to inordinate action by the use of alcoholic drinks. Continued bathing, in this way, will eventually get the skin into such a condition that it cannot act at all, except as it is stimulated, no more than the drunkard's stomach can, unless stimulated by spirits.

Don't think that I would discourage the external use of water. I merely make these remarks to apprise you that even as simple an agent as water, may do harm if used improperly. I would encourage its use in the temperate manner I have recommended. It will enable you to enjoy the blessing of health in a greater degree; it will enable you to accomplish more labor, and, what is not a small item, it will enable you to cheat the doctor out of many a bill.

The consequence of letting the skin remain uncleansed is to change these little perspiratory ducts into absorbent vessels; to change their action entirely. Instead of pouring out perspiration, they go to work and take up the old dried perspiration and dirt, on the surface of the skin, and carry it back into the circulation. In this way one is continually eating himself over again—becoming one of the worst of cannibals. This power of absorption, that the perspiratory ducts possess, is illustrated to every one in the case of the cow and the hog. Let a milch cow lie in a dirty stable, and see how soon the taste of the milk will show it. Or let hogs lie continually in their own filth, and you can notice it in the taste of the pork. These filthy substances, that the animals lie in, become part of the milk and flesh.

I have known farmers, who were aware of this fact, curry not only their horses, but all their other cattle and hogs regularly, so that these filthy substances should not be taken into the blood. It is far worse for this filth to be taken in by the skin than by the mouth; for when it is absorbed by the skin it goes directly into the blood in an unpurified condition, but when it is taken in by the mouth and stomach, it is purified before it enters the blood. Physicians take advantage of this power of the skin in introducing medicines into the system, when some difficulty of the stomach or bowels prevents the medicine being taken internally. I have frequently seen persons salivated, by rubbing mercurial ointment on the skin. When the cuticle is taken off, as in the case of blisters, the mouths of the perspiratory ducts become more exposed, and if any fine substance be sprinkled on, it will immediately be taken up by these ducts and carried into the blood, and affect the system as quick and as surely as if taken into the stomach. The plague and other epidemic diseases, where the cause exists in the air, are said to have been warded off by persons clothing themselves in oiled garments, so that the poison could not come in contact with the skin and be absorbed. But I should fear the preventative would be about as bad as the disease. And history says, that a general in old times found it so, who, by clothing his men in oiled garments, to keep out the plague lost nearly all of them from the effects of the garments in preventing the passing off of the perspiration.

The diseases of the skin form a great variety, more so than of any other structure; and many of their

characteristics are very singular. They spread rapidly, sometimes going over a whole limb in a few hours.

These diseases sympathize greatly with the lining membrane of the alimentary canal — that is, the stomach and bowels. Many of these cutaneous diseases are caused by derangements of the alimentary canal, and cannot be cured until the difficulty is removed from the bowels. Eruptions on the skin are sometimes produced merely by eating some substance that does not agree with the stomach, as the eating of certain kinds of fish with some persons, and the eating of strong cheese with others will produce an eruption. A majority of the eruptions in children are caused by improprieties in diet, and are easily removed by simply clearing these irritating substances from the bowels, and taking measures to prevent their accumulating again. Many mothers, under the erroneous impression that the difficulty lies wholly in the skin, are continually daubing on some kind of grease or liniment "to drive it away," as they call it. But the more they daub, as a general thing, the more it will not go. The measles, small-pox, and scarlet fever are specific diseases of the skin coming from contagion, and not depending on any particular condition of the bowels or general system. Their great danger is in extending along the skin to the mucous membrane lining the mouth, or the inner skin, thence along it into the lungs and bowels, producing inflammation in these vital parts similar to that on the surface.

And here it may be as well to mention a general law of diseased structure: that inflammation will always extend along the same kind of structure that

it has commenced in, rather than go to another structure. And when a disease leaves a part, for instance, the external skin, to go to some other part, it goes to a structure nearest like the one it left: that is, it is most apt to go to the mucous membrane lining the bowels or lungs, which resembles the structure of the skin nearer than any other. To give another illustration, that of rheumatism; when rheumatism leaves a joint, existing, as it does, in a serous membrane in the joint, it goes to some other serous membrane, either in a joint or to the serous membrane covering the bowels, or lungs, or heart, or brain. In rheumatism of the muscles it skips from one muscle to another in different parts of the body. Sometimes it goes to the muscular part of the heart, when the consequences are fatal. In diseases of the skin it should be kept clean, the bowels should be kept in a proper condition, sudden changes in temperature should be avoided, and a light diet should be used. Cool drinks should be used instead of hot, stimulating ones, as are generally recommended.

The skin is more delicate in structure in some parts than in others. Around the joints, where mobility is requisite, it is thin and pliable. The skin covering the lip, where the external skin gradually merges into mucous membrane or internal skin, is very delicate; at least this is the general opinion among young men. Whether they secrete honey or not I am not positive. I suppose they do though, for we frequently hear of "honied lips." The skin covering the cheeks is transparent, allowing the arterial blood to be seen through it. It is capable of being injected with blood, under the influence of certain emotions, producing the blush.

What these emotions are that produce blushing, each individual best knows for him or herself. The cheek undergoes a process of hardening sometimes that renders it incapable of blushing, either from modesty or shame. A sort of a moral, or rather, immoral tanning rendering it honor-proof. This kind of cheek might be styled a patent leather cheek — always smooth and always shining, but incapable of changing its color either for the better or worse. It makes a very good commercial cheek. If it were not for its protective power the consciences of certain public men would be awfully scorched by the rays of truth.

The skin covering the forehead is of a clear, white color. It is said sometimes to become alloyed with brass. Whether this is actually the case, or whether it is a slander on human nature I leave you to decide. Certain it is, however, that some foreheads are proof against all moral arrows, turning them off as a duck's back does a drop of water.

The skin is the seat of the sense of touch. This sense exists in its greatest perfection in the tips of the fingers, where the extremities of the nerves devoted to this sense, terminate. By bringing these nervous terminations in contact with external objects, a sensation is conveyed to the brain, which we call the sensation of touch. What is called the sixth sense of some writers, is but the sense of touch made extremely sensitive by education. I mean that power that enables bats and blind persons to tell when they are near an object without touching it; it is owing probably to their being able to feel the reaction of the air from the object when they approach it. Insects have the sense of touch located in long hairs or feelers.

THE HAIR.

The hair comes next under consideration as an appendage to the skin. It grows from a root in the true skin; as it passes through the rete mucosum and cuticle it receives a reflected covering from each. It has a sameness of structure, having no vessel or nerve, growing entirely from vessels at the root. The hair has beards on the outside, similar to wheat beards, directed towards the outer end of the hair, thus causing the hair to lie in the same direction. The direction of these beards can be ascertained by cutting a hair with a razor. The hair is cut much easier by cutting towards the root against the direction of the beards.

It is useless to prescribe rules for the treatment of the hair. Fashion is bound to rule here. If Fashion says, wear the hair long, long it must be. If she says, wear a cue, down grows the pig-tail. At one time it was fashionable to wear a huge heap of frizzled hair on the head, after the fashion of the Poland hen. It has always been fashionable to powder and oil the hair, which is probably not injurious, if these subtances are kept washed carefully from the skin. Coloring the hair is practiced very extensively now, by those who do not think gray or red hairs, or sandy whiskers, honorable. If any of you undertake to color your whiskers though, I hope you will not be as unfortunate as a medical student I knew once, by the name of Grimes—old Grimes' son, I suppose—who colored about one-half his face by the operation, so that it staid colored for about a month. False hair and curls frequently add to the wearer's beauty, and are not to be condemned if the wearer does not use them to get a companion under false pretenses. Short hair is cer-

tainly the most convenient, enabling the wearer to comb and clean the scalp conveniently.

THE BEARD.

Nature undoubtedly designed that the beard should be permitted to grow, or she would not have placed it there, having created nothing in vain. It might have been designed merely to distinguish the male from the female when both are clothed the same; but difference in clothing has rendered this mark of distinction unnecessary, and so we moderns, as a general thing, keep the face shaved. I think that every mother's son of us will admit that this shaving operation is a real bore, consuming a year or two of every man's life—and then the torture one endures if the razor is dull. And if the razor is sharp the case is not much better, for you are continually cutting and slashing yourself, and pulling the wool off from all the old hats to stop the blood with. And then what a fix the young gentlemen are in, if they are not pretty closely shaved, at a bussing bee, currying off their sweethearts' faces till they are fairly sore. Why it is perfectly horrible! Those fuzzy young gentlemen are to be envied, I assure you.

Grayness is owing to a want of coloring matter in the hair. Certain depressing emotions have a tendency to turn the hair gray. Excessive fright is said to have turned the hair gray suddenly. The story has often been related of the boy who was being let down by means of a rope, to get birds' eggs, over a precipice in an island north of England; the rope being almost severed by a sharp rock, so frightened the boy that, when he was drawn up, his hair was discovered to be turned white.

When the hair falls off owing to a want of action of the roots of the hair, washing and rubbing the scalp with slightly stimulating substances will have a tendency to increase the growth of the hair, unless the roots are entirely destroyed, and then you might as well try to raise a crop of hair on the top of a white oak stump. All the hair tonics in the world can't raise a single hair unless there is a root to start with. You could raise a crop of apple-trees from a piece of ground, by pouring Jayne's hair tonic over it, just as quick as you could raise a crop of hair from a bald scalp without any hair roots in it. Shaving the head repeatedly is about as good a way as any to stimulate the growth of the hair.

The roots of the hair are subject to disease, particularly the roots of the eyelashes. They should be kept clean and a weak ointment of red precipitate applied. What is called standing up of the hair in fright, is probably owing to an involuntary retraction of the muscle of the scalp. Animals have a muscular structure under the skin, on purpose to move the hair and skin so as to dislodge insects. There are accounts of individuals having feeling or sensation in their hair, causing them pain to have it cut.

THE NAILS.

The nails are another appendage of the skin. They have no sensation except near the root. The nails are parts of the cuticle, secreted in the same manner, composed of the same material, but much more dense and hard, to answer a different purpose; that is, to protect the tactile extremities of the fingers. Beside protecting the ends of the fingers, the nails give greater accuracy to the sense of touch by affording a

firm basis, on which the nerves of sensation can be pressed. Among the South Sea Islanders the nails are permitted to grow to their full extent, resembling bears' claws more than human nails. Carelessness in trimming the nails, particularly the toe nails, will produce what are called "*hang nails*," a very painful inflammation at the sides of the nails. They are best cured by cutting off the sides of the nails, where they goad the flesh, and scraping the top of the nail very thin, so that the sides of the nail will retract. If morbid growths, called "*proud flesh*," form there, touch them with caustic.

EXTERNAL COVERINGS OF ANIMALS.

The external covering of the inferior animals is various, according to the element they are designed to move in, their peculiar habits, and the climate they naturally belong to.

The natural covering of man is not sufficient to protect him against the inclemencies of all climates, indicating beyond a doubt, that it was designed he should furnish himself with artificial clothing. Man could not, by any physical training, so harden his system as to enable him to exist in an extreme northern latitude without artificial covering. Not so with the inferior animals. Nature has furnished each one with sufficient covering to live comfortably in the place and element it was designed to live. It has furnished the oyster with a hard shell to resist the action of the sea. It has furnished most all four-footed animals with a thick skin and a covering of hair. Those living in the frigid zones are furnished with a very thick coat of hair, and that of a light color to prevent the escape of the animal heat. Animals living in the

torrid zone, have a thinner covering. The Mexican dog could no more live in the frigid zone than the polar bear could live in the torrid zone. Sheep, taken from a cold to a warm climate, lose the fineness and thickness of their fleeces, their wool partaking more of the nature of hair.

Birds are furnished with a protection of feathers—the very best protection against cold that possibly could be devised. Water-fowl are furnished with an abundant supply of oil to make their feathers impervious to water. When warm weather comes and less covering is needed, quadrupeds and birds shed their hair and feathers.

Animals having no hair or wool, as the elephant and rhinoceros, are furnished with a thick, resisting skin. The skin of serpents is smooth, so as to slip easily over the ground. Fish are provided with coverings adapted to their element. The skin of the whale is covered with an oily substance to protect it from the water. Other fish, instead of a cuticle, have scales. Some have a complete bony case, as the nautilus, which is provided with a bony covering like a boat; it has two little arms, between which is stretched a thin web like the wing of a bat. When the nautilus wishes to sail, it throws out its ballast of water, which brings it to the surface; it then hoists its little sail and skips over the waves before the wind, like any other ship. When it is tired of gliding over the waves it takes in its sail, scuttles its boat, and sinks.

Insects and reptiles shed their skins several times during their short lives. This is called moulting. I think this would have been a good arrangement for that part of the human family that has such an in-

stinctive horror of water. It would enable them to come out with a clean skin, at least once a year.

The skin, or rather the follicles of the skin in many animals, secrete a fluid with a peculiar odor by which the animal is known. You can easily distinguish a horse from a dog, or a sheep from a hog, by the sense of smell alone. It is a popular opinion that the negro can be distinguished from the white man by his odor. I don't deny but that there may be noses delicate enough to do this.

Fluids of different odors are secreted in different parts of the body, both in man and animals. Thus the secretion of the armpits is easily distinguished from that of the soles of the feet. It is the odor of this secretion of the feet, that enables the dog to follow the tracks of different animals; the dog knowing, by the peculiar odor, what animal he is following. There is a difference in this odor even between individuals, because the dog will distinguish the footsteps of his master from the footsteps of a thousand other individuals.

Fashion has decided that the peculiar odors of certain animals are more becoming to us than that of our own. The musk-deer and muskrat stand here preeminent. It is universally decided that they are superior to man in this respect, and we are continually hunting them down and robbing them of their treasure to scent ourselves with. That other odoriferous animal, the skunk, has great reason to be thankful that his is not a fashionable odor, although I don't see why it should not be, it is certainly much stronger and more penetrating, than that of the muskrat.

The claws and hoofs in animals correspond to the nails in man, and grow in the same manner.

LECTURE III.

THE OSSEOUS OR BONY SYSTEM.

We next come to the internal structure of the body. We will first commence with the osseous or bony system. This might be called the framework of the body to which is fastened the siding, the roof, the partitions, and the machinery of the human structure. Bone is composed of an earthy and an animal part, intimately mixed together. By putting a bone in some fluid that will eat up the earthy part of it, muriatic acid, for instance, you can obtain the animal or gelatinous part separate. It will retain the shape of the bone, but will have lost its hardness and stiffness. You can twist it round like a piece of whalebone. If you burn a bone, you will destroy the animal part but not the earthy part. The shape of the bone will remain as before; but it will have lost its toughness and will break from the slightest blow. This explains to you perfectly the uses of the two different parts that compose bone. The earthy part is to give it firmness and stability, so that it will not bend, and the animal part is to give it toughness, so that it will not break. Sometimes the relative quantity of one of these parts is too small in the bones of the living individual. When the earthy portion is too small the limbs bend and grow crooked, as in the case of rickety children. The thigh bones of Madame Supiot were so flexible from a deficiency of earthy matter in them, that she

could lay her feet on each side of her head; her other bones were equally flexible. At her death she was two feet two inches shorter than before she was afflicted with this disease.

When the animal portion is too small the bones will break from the slighest jar; the contraction of the muscles have been known to fracture them. This state of the bones is called *fragilitas ossium*, or brittleness of the bones. It is often produced by scurvy. During Lord Anson's voyage around the globe, his seamen were so afflicted with brittleness of the bones, from the effects of scurvy, that wherever their bones had been broken, they came apart again. Caries of the bone is where the bone is eaten away, as in decayed teeth. The bones sometimes enlarge to twice their natural size; they also change into a fleshy substance. Necrosis is a death of the bone corresponding to mortification in the flesh. Matter will sometimes form in the interior of a bone and eat its way out under the skin.

The cause of this diseased condition of the bones is generally constitutional, owing, as most diseased conditions are, to some impropriety in the way of living, and can be cured only by correcting that impropriety. In the growth of the bones of the child, the animal or gelatinous portion is formed first; then the earthy portion is gradually diffused through it, commencing from points and extending until it becomes intimately mixed with the animal portion of the whole bone. This excess of animal matter in the bones of infants makes their bones weaker and more easily bent than in after life. Hence the impropriety of encouraging children to stand alone sooner than they have a natural disposition to. It is almost sure to make them "bandy-legged." In old persons it is just

the reverse. The earthy portion predominates, making their bones more brittle than in youth.

Bones are divided into long, short, and broad bones; the bones of the arms and legs are specimens of long bones; those of the wrist and instep, of short bones, and those of the head, and shoulders, and hips, of broad bones. The shaft of long bones is very firm, hollow in the middle, and filled with marrow. They are larger at the ends and more spongy in texture than in the shaft. This is to form a large surface for the joint, and to prevent too much jarring of the bone, which would be the case if the extremities of the bones were as firm and inelastic as the shaft. The end of the long bones are covered with cartilage so as to present a smooth surface for articulating with other bones, to form joints. The hollows of long bones are filled with a fatty substance called marrow. Physiologists differ as to the use of marrow in bones. Some aver it is to prevent the bones from becoming too dry; others, that it is placed there as a reserve, to supply the system with nourishment when food cannot be obtained. In birds these hollows are filled with air to give lightness to the body. The question naturally arises, why is the shaft of the long bone made cylindrical or hollow? Would it not occupy less space if it were solid? Here, again, we see what a scientific mechanic Nature is, for she knows and has put in practice the law that the same quantity of matter arranged in the form of a hollow cylinder, is stronger that when arranged in any other shape. The long bones have but one small hole penetrating their sides: this is for the passage of the vessels for the nourishment of its internal structure. The body of the bone is nourished by a membrane covering the bone, called the periosteum; also

by nutritive vessels entering the spongy part of the bone at the ends. The short bones are principally found in the wrist and instep, where little motion is required of them. They are small, irregularly-shaped bones, resembling pebbles; but they are adapted perfectly to their use, and they are so framed together that they act like the stones in an arch—the more they are resisted the stronger they are. The broad bones are found in the pelvis or hip bones, in the shoulders and head. They are composed of two thin plates of hard bone, between which is a spongy structure so that the plates may yield, when struck, without being broken. The skeleton is divided, for the sake of description, into the head, trunk, the upper and lower extremities. The head, in infancy, is divided into a number of bones, which are movable on each other, allowing the head to be pressed into almost any shape. In this way an infant's head can be made at least a quarter longer and a quarter less in circumference than natural. As the child grows these bones take their proper places, and their edges grow together, forming one whole bone, the skull. The bones of the skull are flat, concave internally, and convex externally. They are formed of two plates, the external and the internal, and a spongy layer between the two plates called the diploe. The diploe is elastic, and allows the external plate to give when struck, so as not to injure the brain by blows.

We see illustrated here, as in every other part of the human body, and in fact, as in every part of the animal and vegetable kingdom, the infinite wisdom of an all-wise Creator. The most insignificant part of the most insignificant insect is eloquent of the wisdom of God. Everything in Nature is perfectly adapted to the purpose for which it was designed.

No improvement in any natural organization can be suggested by the acutest mind. The two plates of the skull are separated from each other in some places, as above the eyes, forming cells. These cells, above the eyes, communicate with the upper part of the nose, and sometimes when a person has a bad cold, they discharge matter into the nose. The bones into which the skull is divided in infancy, are called the Os Frontis, or bone of the forehead. The two Parietal bones, forming the top and sides of the skull. The two Temporal bones, situated at the temples. The Occipital bone, forming the back part of the skull. The Sphenoid bone, forming the under part, or base of the skull, and the Ethmoid, situated internally, behind the bones of the face, joining the frontal, temporal and sphenoid bones. The skull, as a whole, is formed in the best possible shape for the protection of the brain, which it contains. Every part of its external surface where it is exposed to blows, is in the shape of an arch. You cannot strike the head anywhere, but what you strike on an arch. Now every mechanic knows, that an arch is the strongest possible structure. If the skull were any other shape, one-tenth part of the force would break it. The lower portion of the front part of the skull is not of this shape, because there is no need of it; the eyes and the bones of the face being placed before it, and affording sufficient protection. The skull is hollow, and of irregular shape within, to accommodate the different portions of the brain. It is pierced in different parts by foramina or holes, for the passage of nerves and bloodvessels. You can trace the courses of some of the bloodvessels by their beds in the bone. At the base of the skull is the Foramen Magnum, or large hole of the skull, through

which passes the spinal nerve, called, generally, the Spinal Marrow, or marrow of the back bone, the largest nerve in the body. The arrangement of all these holes is perfect. The one for the passage of the main artery, which carries the blood directly from the heart to the brain, is curved, so that the force of each jet of blood as it comes from the heart, is lost materially, by dashing against the bone, otherwise the force with which the blood has to be sent to carry it up the neck would jar the brain too much. The hole for the passage of the venous blood out of the brain, is large and free, so as to prevent the blood from being stopped. The nerves of sensation pass out through the different holes in the front and lower part of the skull. Where the olfactory, or smelling nerve passes out, the bone is pierced by a great many small holes, giving the bone the appearance of a sieve. The hole where the optic nerve passes out is round and nearly straight. The auditory nerve passes out at the end of the triangular bone, in which is situated the organ of hearing. The ridges through the inside of the skull are for the attachment of membranes, that keep the different parts of the brain separate. The bones of the face are fastened to those of the head; they are the two malar or cheek bones; the two nasal bones forming the bridge of the nose, the palate bone; the upper maxillary or upper jaw-bone, and two sets of little bones inside the nose: called the turbinated bones; and the vomer, which with the palate bone separates the nose into two parts. The upper jaw-bone has a cavity or hollow on each side, which is sometimes the seat of inflammation; when matter collects in it, a tooth has to be drawn, and a hole drilled up into the cavity, to let the matter out. On the inside of the

nose, on each side, is a little hole, the opening of a tube that goes up to the inner corner of the eye, through which the tears pass from the eye to the nose. Sometimes this little tube gets stopped up, so that the tears cannot escape into the nose, but run over the lids on the cheek. This difficulty can be removed by opening this tube and enlarging it with bougies, or, by inserting a small silver tube. The lower jaw-bone has the shape of a horse-shoe, bent up at the heel. At infancy, it is bent but very little at the angle; as the teeth come in, it becomes more bent; when the teeth come out again in old age, it becomes straight again, as in infancy. Thus the child's lower jaw and the aged person's have the same shape. This provision is to enable the jaws to come together at all ages, so that mastication, or chewing, can be performed. When this change takes place in persons with long noses, they are apt to be provided with a pair of pinchers, the nose and the chin being the forks thereof. Surmounting the internal edge of each jaw-bone is a ridge, called the alveolar processes, into which the teeth are fastened. When the second or permanent teeth come out, these processes grow much less in size, and become covered with the gum; and this gum becomes hardened, so that it is a substitute for teeth, enabling a person to "Gum it," as the phrase is. The lower jaw is fastened to the upper jaw by means of ligaments and muscles.

THE TEETH.

The teeth differ, in some respects, from the other bones of the body, in their growth, in their exposure to the air, in their varying in number at different periods of life, and in their not uniting again, when

broken. The first, or milk teeth, are twenty in number. Between the ages of six and fourteen, the roots of the first set of teeth die and become absorbed, causing the teeth to fall out, to give place for the permanent teeth, which are thirty-two in number—sixteen above, and sixteen below, each tooth corresponding with the one opposite it on the same jaw. In each jaw are four incisors or cutting teeth, placed in front; two cuspides, or eye-teeth, called so from their supposed resemblance to a spear, placed next the incisors; four bicuspides, or double spear teeth, placed next the cuspides; four molar or grinding teeth, placed next the bicuspides, and two wisdom teeth, situated the farthest back. The wisdom teeth do not appear until the person is about twenty years old, by which time it is naturally supposed, that one ought to have a little wisdom. I fear, however, that if the wisdom teeth did not appear until their owner became wise, there would once in a while be a full-grown jaw minus these four teeth. Each tooth is composed of a crown and root. The crown, or that portion which is above the gum, is covered externally with a hard enamel, which cannot be injured by the air; in this respect, unlike any other bone of the body; for if any other bone be exposed to the air, it becomes destroyed. The inner substance of the crown of the tooth is a hard ivory; in the center is a hollow, containing blood-vessels for the nourishment of the tooth, and a nerve. The root of the tooth is of ordinary bone, and fastened in the alveolar processes of the jaw-bone. In drawing the teeth, a piece of this alveolar process frequently sticks to the tooth, when the doctor gets the credit of breaking the jaw-bone. When inflammation takes place in the tooth, the bloodvessels become enlarged,

and press the nerve against the side of the tooth, causing toothache. If the parts about the nerve could yield when the nerve is pressed by the enlarged blood-vessels, as in the soft parts of the body, inflammation in the tooth would not be so extremely painful as it is. What is called the jumping toothache, is caused by blood rushing in the artery, and pressing on the nerve at each contraction of the heart. The enamel is what preserves the tooth from decay; as soon as this is destroyed, the inner or bony structure of the tooth will decay as soon as any other bone that is exposed to the air.

Hot or cold drinks or food will crack this enamel, or biting hard substances; and as soon as this crack is formed, decay commences and keeps on eating until it reaches the cavity, exposing the nerve and bloodvessels contained there. Drawing in hot smoke also cracks this enamel; therefore, I would advise those who will not give up this bad habit entirely, at least to draw their smoke through a long pipe-stem, as the Turks do, so that the smoke has time to cool. Using strong acids to excess, as strong vinegar and sour cider, or sour food will act chemically on the teeth; the acid acting on the lime of the tooth and destroying it rapidly.

Some have an idea that the use of tobacco will preserve the teeth, but I think not. It may deaden the feeling of the gums and teeth, but I think it will not prevent their decay; and even if it should, the remedy would be worse than the disease. The injury that the whole system would receive from the use of tobacco would be greater than the benefit that the teeth would derive.

As soon as you discover the enamel of your teeth to be cracked, or eaten through in any place, the

sooner you attend to it the better. Go to an honest dentist, have him clean the cavity thoroughly, and plug it with gold; this will effectually stop the decay of the tooth at that place. I believe, if it is plugged properly and in time, that the tooth will last as long as if it never had been decayed. I had one of my front teeth plugged five years ago, it appears as sound now as ever. I should probably have lost the tooth in less than a year if I had not had it plugged. But do not let a dentist plug your teeth with anything but gold. The compositions that are sometimes used by cheap dentists do the teeth more harm than good. I was imposed on, when I was a boy, by a villainous dentist, who used an amalgam and charged me with gold-filling, by which means I lost the teeth he filled.

When the tooth becomes decayed, so as to expose the nerve, it cannot be filled; then the sooner it is drawn the better; for a decayed tooth is always a source of irritation, causing sometimes a very painful disease of the face called tic-douloureux. Decayed teeth also taint the breath.

If the milk teeth do not fall out by the time the second teeth come through they should be drawn to prevent the second teeth coming in crooked. When the second teeth are lost, they can be replaced by artificial ones. Artificial teeth add not only to the beauty of the individual, but to his real comfort, and to his health by enabling him to masticate properly. Artificial teeth, as a general thing, look better than the natural ones, being more regular, and are easily kept clean. Now don't any of you go and get your natural sound teeth taken out in order to have a new and whiter set. If you have a good set of teeth, wash them with a soft brush and water every

morning. Don't use very hot or very cold drinks or food, nor much acid, and your natural teeth will look well enough.

The jaws of the inferior animals differ from those of man in being longer and more protuberant. The jaws of carnivorous animals have only one motion, that is, to open and shut like a pair of shears; while the jaws of graminivorous animals have two motions—a vertical, or up and down motion, and a lateral motion, or a motion sidewise.

The teeth of the inferior animals are constructed for the wants of the animal. The teeth of gnawers are made long, and the enamel or hard part, exists only on the outside like a chisel, the inside of the tooth being soft. In this manner the tooth keeps sharp, in the same way that a chisel does, by the inside wearing away and leaving the external enamel. Their teeth keep growing in length, and if they cannot get hard substances to eat, their teeth will grow so long as to prevent them from being used. The teeth of carnivorous animals are sharp for seizing and tearing their prey. Those of graminivorous animals are wide and edgelike in front, for cutting off grass and twigs, broad and flat behind, and ridged for grinding their food.

All quadrupeds, or four-footed animals, have teeth, except the ant-eaters. These do not need them, for they get their living by lying down at the side of an ant-hill, and protruding their tongue until it gets covered with ants, and then they draw it in and swallow their dupes. So we see that man is not the only animal that takes in those who put confidence in him.

The elephant, who follows grinding for a living, having to grind a large quantity every day, in order

to nourish his huge body, is continually supplied with new sets of grinders as long as he lives — having sometimes as many as six or eight new sets of teeth. They come in from behind, pressing the old, worn tooth out, forward.

The age of most domestic animals can be ascertained by the teeth. This would be a bad idea with us. I fear, it would prevent many an old bachelor and old maid getting a companion.

THE SPINE OR BACK-BONE.

This is composed of twenty-four separate bones, each placed the one upon the other like a pile of brick. Through each of these bones, vertically, passes a large hole, which, when the bones are together, forms a continuous tube or canal from the large hole at the bottom of the skull, where the first or uppermost bone of the spine is attached, to the extremity of the sacrum, the bone on which the spine rests. Through this spinal canal, passes the spinal cord or marrow, as as it is generally called, the largest nerve of the body, or rather, it is all the nerves of the trunk and extremities bound up in one cord. Between each of the bones of the spine, coming out on each side, is a much smaller hole, through which comes out a nerve from the spinal cord, to supply the parts nearest with nervous influence. There are twenty-five pairs of these holes coming out from between the different bones of the spine, and five, sometimes six, pairs coming out from the sacrum. The spinal bones or vertebræ have little prominences of bone coming out from their sides and from their back part, to which muscles are attached for moving the spine, and for moving other parts of the body. Covering the face of each bone,

where it joins with the other, is a cartilaginous or gristly substance, to make the spinal column elastic, so as to prevent the brain being jarred, as it otherwise would be at every step. Another advantage of this cartilage is to allow the spine to bend in different directions. In old persons this cartilage becomes harder or more of the nature of bone, causing them to be more careful in walking, so as to prevent concussions or jarring of the brain. You notice, also, that their back is more stiff, not bent in different directions so easily as in youth.

The bones of the different parts of the spine are a little different in their shape. Those of the neck (called the cervical vertebræ) are flat and shaped so as to afford great rotary motion, enabling us to turn our head in all directions without turning our body. The cervical vertebræ are seven in number. Below these are the dorsal vertebræ, twelve in number, situated behind the chest; they are a little larger than the cervical vertebræ. They are shaped so as to admit of but little motion, because much motion here would interfere with the action of the heart and lungs. To the sides of the dorsal vertebræ are attached the heads of the twelve ribs; the other extremeties of the ribs are attached to the sternum or breast-bone. The five lower bones of the spine (the lumbar vertebræ) are still larger than the dorsal vertebræ; their faces where they join together are more convex, so as to allow of considerable motion, backward and forward and sideways. The shape of the spine, as a whole, is that of a small letter, *f*, projecting forward at the top, backward at the chest, to give room for the lungs, and projecting forward again at the loins, where the bowels occupy less room. The spine is so shaped that a per-

pendicular line, drawn through its curves, will fall within the base of the feet, proving that the natural attitude of man is an erect one. Diseases that weaken the bony or muscular parts of our bodies, and improper attitudes in sitting, standing, walking, or riding will change the shape of the spine, producing, what is called, curvature of the spine, or hunchback.

The way children sit in school, generally, is calculated to give them curvature of the spine if they are at all predisposed to it. The benches they are required to sit on, are mostly without backs to them, and so high that they are not able to put their feet to the floor—keeping the little fellows in a continual state of torture. I would recommend, as an improvement to this plan, that instead of high benches for low children to sit on, our school-rooms be provided with a lot of meat-hooks suspended from the ceiling by cords, so that each little codger can be hung up by the coat collar.

The writing desks are also wrongly constructed. All are of the same height, no difference what the height of the scholar that has to use them, whether three feet or five. The children must accommodate themselves to the benches—not the benches to the children—on the principle of the ancient tyrant who made all his guests fit a certain bedstead. It makes me think of a story one of my neighbors told me about a coffin that was made for an Indian here some years ago; when the dead Indian's companions came to put him in they found the coffin was too short. A sort of a wag who was present, told the Indians to go out a few minutes and he would fix the matter; as soon as they were out he took a hatchet and cut the Indian's feet off, and folded them up, and boxed the corpse up

to the perfect satisfaction of his friends. Now we don't exactly cut off the feet of the children too high for the benches, but we disfigure them in another way by making them stoop and sit in an unnatural position, and thus injure their systems for life; for just as the child sits or walks the future man or woman will. The children that are too low for the writing desks have to stretch one side up to it as high as they can, producing, in this way, curvature of the spine. The only healthy position is an erect one. When your body gets tired from standing, or sitting, or walking erect, don't ease it by lopping over like a frost-bitten cornstalk; but lie down in a straight position till you are able to assume an erect one again. The spinal column or back-bone rests on the sacrum, which is the hindermost bone of the pelvis.

The pelvis is called so from its supposed resemblance to a basin. It constitutes the foundation of the frame, on which all the other parts act. In infancy, the bones of the pelvis are divided into seven different bones. The two pubic, two iliac, two ischiatic, and the sacrum. The sacrum is called thus, from its being the part of the animal that the ancients offered in sacrifice. These bones grow together and become one bone as the child grows older. The bones of the pelvis are large and strong. The muscles that move the legs arise principally from the bones of the pelvis. The pelvis is much broader in the female than in the male. This peculiarity of the female is rendered more striking by her manner of clothing, having but little clothing on the upper part of the body, the most of it being on the lower part, in the form of skirts, tied around the waist; while directly the reverse is the case with the male, having the most

of his clothing around the upper part of his body, and the least around his hips and legs. The way the fashion was this last year, it makes a man look perfectly ridiculous, his coat being twice too big for him, and his pants fitting close to the skin, looking as though he had dressed up on purpose to be laughed at—resembling as near as I can make a comparison, a Shanghai rooster with an overcoat on. The female's dress is big at the bottom, and little at the top, while the male's is little at the bottom, and big at the top.

The pelvis sits on the heads of the thigh-bones, which are round like balls, and fit into corresponding round cavities in the pelvis. The heads of the thigh-bones are held in their sockets by a strong ligament, that incloses the joint like a sack, one end being fastened around the head of the thigh-bone, and the other around the edge of the cavity, and by a strong round ligament, like a cord going from the center of the head of the bone to the upper part of the hollow. The thigh-bones are large and strong, as they necessarily must be, to support the weight of the body. To the thigh-bones, are attached those large muscles that move the thigh in different directions. The other ends of these muscles are fastened to the bones of the pelvis, and to the spine. The lower end of the femur, or thigh-bone, is articulated, so as to form a joint with the tibia or bone of the leg; the ends of the bones forming the joint are bound together with strong ligaments. In front of this joint, between the extremities of the two bones, is the round, flat bone, called the patella, or knee-pan, designed to protect the joint from injury, and to assist the motion of the leg. The patella, or knee-pan, is attached below, by means of a strong ligament to the tibia or leg bone,

and above, it is fastened to the large muscles that form the fleshy part of the front of the thigh, whose contraction draws the patella, and consequently, the leg upward. Beside the tibia, or large bone of the leg, there is another smaller one on the outside of the tibia of the same length, designed to give protection and support to the muscular or fleshy part of the calf of the leg. This bone is called the fibula. These two bones, the tibia and fibula are articulated with the bones of the foot.

BONES OF THE FOOT.

The back part of the foot is composed of several short, thick bones, closely connected together, so as to admit of but little motion, but put together in the form of an arch, giving great strength to that part of the foot on which the weight of the body generally rests. Extending before these are the bones of the middle part of the foot, called the metatarsal bones. They are five in number, corresponding to the number of toes. Then there are three ranges of bones, for the different parts of the toes, except for the big toe, which has but two bones. These ranges of bones are called phalanges; they decrease in size and strength, to the last row. These different bones of the foot are bound together at the joints by ligaments.

The arm has one large bone, called the humerus. The head of the humerus, where it is connected with the shoulder-blade, is round like a ball, like that of the head of the thigh-bone, which allows it to revolve around in all directions. The fore-arm has two bones, the ulna and the radius. The upper end of the ulna is firmly attached by means of a wide, hinge-like joint and strong ligaments, to the lower end of the

humerus; while the radius is attached at the lower end by a hinge-like joint and strong ligament, to the bones of the wrist. Now this radius is fastened at both ends to the side of the ulna, in such a manner as to allow it and the hand to which it is fastened, to revolve around the ulna, thus enabling us to turn our hand. This rotation is called pronation and supination. Pronation, when the palm of the hand is downwards, and supination when the palm of the hand is upwards. The bones of the wrist and fingers are similar to those of the instep and toes, with the exception, that the bones of the fingers are longer, and admit of more motion than those of the toes.

THE RIBS.

The ribs are twelve in number; seven of them called true ribs, and five false or floating ribs. The true ribs are fast at both ends; one end by means of a joint to the back-bone; the other end by means of a cartilage or gristle to breast-bone or sternum. The other five false ribs are fast but at one end, where they join the back-bone; the other ends are loose or floating. The ribs are constructed so as to expand the chest laterally or outward, more than vertically, or upward and downward. Hence the impropriety of wearing clothes which fit tight around the breast, preventing the due expansion of the lungs, and consequently a due inhalation of air.

There are thousands of persons in our country who are opposed to capital punishment—who revolt at the idea of hanging a man until he is dead just because he has killed somebody, who are hanging themselves every day of their lives. They don't exactly hang themselves by the neck, but they do by the breast,

which is just as bad. The only difference is, that strangulation is produced a little higher up, in hanging by the neck than it is in hanging by the breast. The Sternum, or Breast-bone, runs down through the middle of the front part of the chest; the front ends of the ribs are fastened to it. This sternum is Nature's corset-board, and a much better one it is than the stiff, hard ones that Art makes of hickory, or whalebone, or even steel.

There is one great mistake that Nature committed, though (or at least we moderns think so) when she made the framework of the chest, she ought to have made another set of ribs to go up and down; for when Nature first got out the patent for this machine, she had no idea that the human body would become so weak as to require lateral stays to keep it from lopping down. But man, or rather woman has taken out a patent for an improvement in this respect, that is, for another set of ribs going up and down. In a few more generations, if we keep on miss-improving, I think we shall need still another set of ribs, crossing the other two sets at an angle, so as to act as braces to them; and then, if hickory timber and whales hold out, we shall be enabled to keep the chest in some sort of shape.

The Shoulder-blade, or Scapula, is situated on the upper and back part of the chest. It is kept in its place by muscles, ligaments and by the Clavicle, or Collar-bone, which is fastened, at one end, to the shoulder-blade and, at the other, to the sternum, or breastbone. The clavicle keeps the shoulder-blade pushed outward and backward, in the same manner that the old Dutch governor keeps the horses apart, when traveling.

The Os Hyoides is a little bone situated in the throat. It resembles the wishbone of a chicken, as near as anything I can compare it to. Its use is to protect and assist the vocal organs, or organs of the voice.

The bones of the internal ear are the smallest bones in the body. I shall treat of them more minutely when speaking of the ear.

LECTURE IV.

THE MUSCULAR SYSTEM.

Muscle is lean meat. Its use in an animal is to produce motion by a contraction of its substance. The muscles are not made merely to cover up the bones and give beauty to the shape. Every muscle, every little strip of lean meat you can find in your own body or in the body of any other animal, was made to produce some kind of motion. There is not a fibre of muscle, or lean meat in the whole body, but that assists in giving motion to some part; and there is not a movement in the whole body, but what is produced by the contraction or relaxation of some muscle or combination of muscles. Walking, talking, the motions of the eye, mouth and face, swallowing and laughing, and the like, are all performed by muscles. The motions of the blood, lungs, bowels, arms, hands, legs, and feet are made by muscles.

A muscle is composed of a bundle of bundles of muscular fibre. These little bundles of muscular fibre that compose a muscle, are called Fasciculi. Each of these fasciculi is composed of a number of still smaller strings of muscular fibre bound together by a delicate sheath of membrane. These small strings, that form the fasciculi, are called the Fibres. They are too small to be seen with the naked eye. You can distinguish the fasciculi, or bundles of fibre, with the naked eye. All of you have noticed the little strings into which you can pull corned beef after it is boiled. These are

the fasciculi or bundles of muscular fibre, of which muscle is composed. Boiling dissolves the substance that binds these little fasciculi together, and enables you to pull them off in strings.

When these little fasciculi or bundles of fibre are bound together to form a muscle, they are covered with a membrane inclosing the whole muscle, to separate it from the other muscles; and some of these muscles, that are used a great deal and their action is required to be very free, are covered with another sheath, in which they act so that their motion cannot possibly be interfered with by any other muscle.

Muscles are of different shapes according to where they are placed, and to the kind of motion they are required to produce.

Some muscles are long and nearly round. The muscles of the arm are of this kind; this shape is called Fusiform or Spindle shape. Another kind is broad and thin. The muscle covering the forehead and scalp, whose contraction draws the eyebrows up, is of this kind. Any other shaped muscle would be in the way here, and would detract very much from a person's beauty; and beside that, it would prevent phrenologists feeling our bumps, and telling us what we liked and what we did not like, what we were made for and what we were not made for. This shaped muscle is called a Radiated muscle. Where a muscle is straight on one side, and sends off a number of little fibres from the other side to be attached to different parts along the line of the muscle, it is called a Penniform muscle, from its resemblance to a goose-quill pen. When the straight part of the muscle has fibres running out from each side, it is called a Bipenniform muscle.

Muscles are fastened at each end. One end of the muscle is generally fastened to some stationary part, as it respects its motion, by the fibres of the muscle itself. The other end of the muscle is generally joined to a tough, inelastic substance called its Cord or Tendon. This cord or tendon is fastened to the part that the muscle is intended to move. On the top of the hands and in the wrist, you can see and feel the cords of the muscles of the Fore-arm. When this cord or tendon is broad and thin, as the muscle is, it is called an Aponeurosis. The tendon of the muscle of the scalp is an aponeurosis.

Now, we have told what muscle is, how muscles are constructed, their different shapes, and how they are fastened at each end. We have told you the use of muscle is to produce motion. How does it do it? By a contraction of its substance lengthwise. By a shortening of the muscle, which must bring its ends and the parts to which those ends are fastened, nearer each other. Now, if one of these parts, to which an end of the muscle is fastened, remains fixed when the muscle contracts, the part to which the other end is fastened must be moved the distance that the muscle shortens. If, for instance, the muscle that bends my fore-arm, which is fastened to a fixed point near the shoulder, contracts, that is, shortens its length, it draws the fore-arm upward, because it cannot draw the part to which the other end is fastened downward. How does a muscle contract, in order to shorten its length, and thus move the part to which it is fastened? When a muscle contracts, the little fasciculi or bundles of fibres of which it is composed, assume a zigzag direction, consequently their ends must approach each other as much as the fasciculi are shortened in leav-

ing their straight direction and taking this zigzag direction.

You can easily illustrate this matter by taking a string and stretching it out straight. This will represent the Fasciculus of a muscle in a state of relaxation or rest. Now draw this string to the right and left, in alternate curves. This will represent the fasciculus when contracted. You will notice the ends will approach each other. If one end be fastened to a fixed object, and the other to one that can move, the object that can move will approach the one that is stationary. Tnis is the philosophy of muscular contraction. This shortening of the little fasciculi makes the muscle thicker in the middle. By grasping your arm, and then bending the fore-arm, you can feel the muscle swell under the hand.

The next question that naturally arises is, What makes these little fasciculi leave their straight direction and take a zigzag one, in order to shorten the muscle? Something must cause them to do it, inasmuch as nothing is produced without a cause. It is the stimulus of the nervous influence that causes this. A nerve goes to every muscle; and this nerve has the power to set the muscle to contracting when it is excited. The nerve can be excited by touching it with a pin. If you cut down to a nerve that goes to a muscle, and touch the nerve with the point of the knife, it will cause the muscle to which the nerve goes, to contract. If you apply electricity to the nerve it will cause the muscle to contract. Even after an animal is dead, you can make it move by exciting the nerves with electricity.

Now that mysterious agent called the Nervous influence, or nervous fluid, or the life-fluid, or any other

name you choose to give it, that agent that goes along the nerves in so singular and inexplicable a manner, has the power of exciting the nerves, and causing them to cause the muscular fasciculi to contract. This nervous influence is set in motion and directed by the will.

For instance, when we want a certain part to move, the will sends an order along the nerve going from the brain to the muscle that moves the part; the muscle contracts, and the part moves. I will further illustrate it; I want to take up an apple and put it to my mouth. My hand is directly over the apple. I want first to open my fingers. I send an order by the nervous telegraph to the Extensor muscles of the fingers, to contract; they contract, and the fingers open. I wish the hand to fall on the apple. I send an order to the muscles whose contraction holds the arm up, to relax; they relax, and my hand falls on the apple. I wish now to grasp the apple with my fingers; I send an order to the Flexor muscles of the fingers to contract. They contract, and my fingers shut on the apple. I wish now to carry the apple to my mouth. I send an order to the flexor muscles of the fore-arm to contract; it contracts, and brings the hand to my mouth. I wish now, to turn my hand over. I send an order to some little muscles of the fore-arm, placed there for that express purpose, to contract; they contract, and my hand is turned over, and the apple is at my mouth, where I wanted it. The act is performed in a hundredth part of the time it takes me to tell it; nevertheless, all these operations have to be gone through with before the apple gets to my mouth. In this way is every motion of our body produced; and not only of our body, but every motion of every other

animal, insect, fish, bird or reptile. Muscular contraction enables the elephant to walk, the snake to crawl, the flea to jump. I think you will all admit, who have ever tried to catch a flea, that its muscular power must be immense, for the size of its body; it would be the same as our jumping two or three hundred feet.

To describe all the muscles of the body, there being about five hundred of them, would occupy more time than we have to spare, therefore I shall only describe the most important ones.

The scalp is covered with a thin muscle, running backward and forward for raising the skin of the forehead and the eyebrows. It is a contraction or shortening of this muscle that produces wrinkles in the forehead. There are some very weak muscles situated about the ear, for the purpose of moving it. One behind, to draw it back; one above, to draw it up, and one before, to draw it forward. Very few persons, however, have the power of using these muscles. There is probably not one person in ten that can move his ears by these muscles. It is likely that our covering the ears by long hair, and by bonnets and hats render these muscles unnecessary. If our hair was cut close, and we wore no head covering, these muscles would be called into use, to keep the flies away from the external ear. I think they would become pretty largely developed in musquito time. The motions of the eyeball and eyelids are produced by a set of delicate little muscles. A little muscle in each eyelid draws it back when we open our eyes. A muscle going all around the eye in the lids, draws the eyelids together like the draw-string to a purse, when we shut our eye. There are little muscles fastened to all sides

of the eyeball to turn it in every direction. When one of these muscles is too short, it draws the eye too much in that direction, producing strabismus or "cross-eye." This can be cured sometimes, by the person wearing a blind over the eye, like one side of a spectacle, in the center of which, is a round hole. By forcing the eye to look continually through this hole it will cause the shortened muscle to become longer, and thus enable the person to look straight. Children who are likely to become cross-eyed should most certainly be subjected to this process; for no deformity is noticed sooner than cross-eyedness. However handsome a person may be otherwise, if he or she is continually "looking two ways for Sunday," as the saying is, it will detract materially from their beauty. There are little muscles running up from the upper lip in different directions, to raise it, to open the nostrils, and to change the shape of the cheek to express different emotions, as mirth by laughing, grief by crying. In pleasurable emotions, the face seems to draw up and look full. In unpleasant emotions the face relaxes and grows longer. There is a good deal of truth in the expression of a person's having a long face when in grief. The lower lip has little muscles that draw it down, and one that draws it up. Most all these muscles as is the case with nearly all the muscles of the body, are attached to bone where they commence, and by their contraction, draw the part to which the other end is fastened, toward the point where it arises from the bone. A circular muscle goes around the mouth, similar to that going around the eye, and for the same purpose—that is, for shutting the mouth. Some men who have talkative wives, are of the opinion, that this muscle does not exist in women, or if it

does, that they never put it in use. The lower jaw is drawn up to the upper jaw, by means of a very powerful muscle, called the Masseter, or Chewing muscle. The use of this, is to mash the food, to enable a person to chew gum and tobacco, and to hold a pipe between the jaws.

In the cheek is a muscle called the Buccinator muscle, which throws the food between the teeth from the outside. The principal use, however, to which it is put now-a-days is to keep the quid of tobacco in motion. And I think that tobacconator would be a more proper name for it than buccinator.

The tongue is composed principally of muscles, some of which are fastened to the lower jaw, some to the little bone down in the throat, called the Hyoid bone; some are fastened to the under side of the skull. So you see that by the contractions of the different muscles of the tongue, it can be drawn in any direction.

The neck is full of small muscles to produce the different motions of the head, of the vocal or talking apparatus, and of the swallowing apparatus. Those for moving the head in different directions commence at the sternum and collar-bone, and from the spine and shoulder: they are fastened to different parts of the lower and outer edges of the skull and lower jaw. Those for the use of the voice go from one of the little cartilages in the throat, called the Larynx, or Adam's apple, to another cartilage called the Cricoid cartilage, and from these cartilages to the hyoid bone, and to the parts of the mouth, and down to the sternum. Those muscles that produce swallowing are arranged one below the other in the gullet, going around it so as to stop it up when they contract; so that when a mouthful of food is forced to the back part of the

mouth, or upper part of the throat, the upper muscles going round the gullet, contract and force the food down to the next set of muscles that go round it in like manner; these contract and force it still farther, and thus the food goes on, being forced down by the contraction of these muscles, until it is forced into the stomach.

The chest is covered with muscles on all sides. In front is the large muscle of the breast, commencing from several of the ribs and fastened to the upper part of the large bone of the arm. Its use is to draw the arm up and toward the body. A set of muscles are fastened at one end to the ribs, and by the other to the bones of the Spine for to raise the ribs, and thus expand the chest, as in breathing. Between each rib, going from one to the other, is a little muscle to assist also in expanding the lungs.

On the back are muscles, fastened at one end to the spine and ribs, and at the other to the skull, for the purpose of moving the head backward; others are fastened to the Shoulder-blade, for the purpose of moving that. Several arise from the shoulder, ribs, and spine, and are attached to the Humerus, to move it in different directions.

The abdomen or belly is covered with broad muscles, fastened to the ribs, spine, back-bone, and bones of the pelvis or hip, so by their contraction, to draw down the ribs in expiration, or forcing the breath from the lungs and to bend the body forward and sideways.

Along the back are muscles attached to the different bones of the spine, for the purpose of bending the back.

The hip and thigh-bones are covered with very large, powerful muscles, for the purpose of moving the thigh and leg. Those that are for moving the thigh

have their origin from the large bones of the hip and lower part of the spine. There are separate muscles attached all around the upper part of the thigh-bone, whose action will move it in all directions. And here I will remark that the muscles designed to move long bones are attached near the end over which the muscle passes, so as to act on the principle of a lever of the third-variety, where the power is applied between the weight to be moved and the fulcrum, and nearest the fulcrum. For instance, the muscles for bending the arm, are attached to the bones of the fore-arm near the elbow joint, so that a very little shortening of the muscle will make the hand move a much greater distance. The muscular force is applied to the bones in the same way that you apply force to a ladder to raise it on end, the farther end of the ladder moving much faster than your hand. It takes a great deal more force to raise a weight in this way, but what is lost in force is gained in rapidity of motion. This is the reason that nature fastened the muscles near the ends of the bones they are intended to move, to enable us to make quick motions with our limbs.

The muscles for moving the leg lie around the thigh. They commence from the upper part of the thigh-bone and lower part of the hip-bones. The principal ones for extending the leg and bringing the foot forward are fastened to the upper part of the Patella or Knee-pan; the knee-pan being fastened to the front part of the large bone of the leg by a strong ligament causes the contraction of the extensor muscles of the leg to bring the foot and leg forward the same as if they were attached directly to the leg. On the back part of the thigh are muscles for drawing the foot and leg back. You can feel their tendons or cords

in the bend of the leg. These tendons are what we call the hamstrings. The back part of the leg and the outer side forming the calf, are composed almost wholly of muscle for moving the foot and toes in different directions. They commence from the upper part of the two bones of the leg and from the lower part of the thigh-bone. They are fastened to the different sides of the different bones of the foot and toes for the purpose of moving the foot and toes. The muscles fastened to the heel are very powerful ones, having to raise the weight of the entire body continually in walking. To the toes go four sets of muscles. One set to bend the toes down, another set to raise the toes, then a set on each side of the toes to draw the toes to either side.

In dancers the muscles of the toes and leg become greatly developed. Fanny Ellsler was able to whirl round, like a top, on the end of her big toe. The small muscle going to the under side of the big toe, having to support her entire weight. These muscles of the leg and foot seem to have a great preference as to the kind of labor they perform. There are many delicate young ladies, the muscles of whose foot and leg are so weak that they cannot support the weight of the body for the young lady to sweep out the parlor, or to enable her to walk a quarter of a mile; but when a dance is on hand, they suddenly acquire strength so as to enable the same young lady to dance all night "till daylight doth appear."

The arm is moved in every direction by means of muscles having their commencement on the breast, neck, and back. The fore-arm is moved backward and forward by muscles commencing at the shoulder and upper part of the humerus, or bone of the arm. Those

that bend the fore-arm, are fastened to the front part of the ulna, near the joint. Those that extend the fore-arm, or draw it backward, are fastened to that point of the ulna on which we lean, when we lean on the elbow. This little point of bone is sometimes broken off, and then the person cannot bend his fore-arm backward. The fore-arm is covered with muscles for turning the radius and the hand (to which it is articulated) over the ulna, and muscles for bending the wrist, and for opening and shutting the fingers. The muscles for turning the radius commence from the lower part of the humerus and are fastened to the radius, so that the contraction of one set will draw the radius over one way, while the contraction of the other set will draw it back again, producing pronation or turning the palm of the hand down, and supination or turning the palm upward.

The fingers are moved to either side by means of short muscles attached to the sides of the bones of the fingers.

It is the education of these muscles moving the wrist and fingers, that produces the skillful violinist. It is the rendering of these little muscles perfectly obedient to the will. In the first place, a violinist must have a musical brain, or musical ear as it is generally called. A natural power to appreciate the qualities of sounds and of their combinations. A man might saw off all the catgut in Christendom, and saw off all the teeth of his neighbors in practicing, without becoming a fiddler, if he has not got a musical brain. The tune and music originate in the brain. The hands are only instruments for its execution.

There are many other sets of muscles, belonging to the ear, circulation of the blood, the vocal or talking

apparatus, and the bowels, which I shall speak of when treating of those parts.

The most of the muscles that I have spoken of as yet, are what are called Voluntary muscles; that is, they are under the control of the will. They do not contract unless the will orders them to. But there is a set of muscles called Involuntary muscles, over which the will has no control. These are the muscles belonging to the circulation of the blood, to respiration or breathing, to the bowels, and to all the vital operations. Those operations must be kept a-going for the preservation of the individual; and it is absolutely necessary that these muscles should not be under the control of the will; for if our heart beat only when we willed it to, or our lungs expanded only when we willed them to, we should be in constant danger of dying from a stoppage of these two organs.

The muscles are enlarged and rendered stronger by regular and temperate exercise. If a person uses his right arm regularly every day, for months in succession, its muscles will become much larger and stronger. A blacksmith's right arm is stronger than any other part of his body. I would as soon be kicked by a mule, as to be struck with a blacksmith's fist. Persons in the habit of walking a great deal, have the muscles of the legs enlarged and strengthened so as to enable them to walk another person down, who may be stronger otherwise, but who has not educated his muscles for walking. There is an old story related of a man by the name of Milo, who commenced lifting every day a calf; as the calf grew, he continued to lift it until it became an ox. By training his muscles every day, he was enabled to lift twice what he could at the start.

Relaxation should follow muscular contraction. You can soon tire out a muscle by the least exertion, if you keep it up continually without relaxation. You cannot hold the weight of your hand out from the body but a short time, without relaxation. The punishment used by some teachers, of making their scholars hold a ruler out at arm's length until the muscles of the arm become perfectly exhausted, is cruel in the extreme. It is not a whit better than the thumbscrews of the Inquisition. Better whip the child to the quick, by half.

Change of work is a great advantage, enabling one to accomplish much more by bringing into action a new and fresh set of muscles. A wood-sawyer will saw and split more wood by sawing a while, and then splitting, than by sawing a whole day and then splitting a day. Youths that are growing, cannot endure so much muscular exertion as when they have attained their growth. Napoleon, who was aware of this fact, complained much to the French government for sending him young men who had not attained their maturity, as recruits, because they were not able to endure his forced marches.

After violent exertion it is better to rest gradually than to sit down and rest suddenly. Perhaps some of you have noticed the fact, that after you have been exercised violently, you feel better to walk around awhile, than to sit still. The remark is common of persons being so tired that they cannot rest at night. Muscular exercise should be at regular times, temperate in its action, and in the open air; and should be of such a nature as to call into action as many muscles of the body as possible. Exercise should not be continued to fatigue, if possible. Clothing should not be so tight as to interfere with the action of the muscles.

Any of you, who have tried to chop with a tight coat on, know this.

The mind exerts a great influence on muscular action. When the mind is enlisted and entertained in the exercise, it acts as a powerful stimulus to the muscles; but when a person merely exercises for the purpose of exercise, without any other object in view, it is a drag. When Napoleon was marching from Moscow with his starving, frozen, and wearied army, his soldiers frequently could hardly be induced to march a step; but let the enemy appear, and they were all life until he was driven away, and then they would relapse again into their exhausted, inactive state.

LECTURE V.

THE NERVOUS SYSTEM.

The Nerves are those little white cords that are found in every part of the system. They commence in minute fibres, each fibre enveloped with a delicate membrane. These minute fibres commence in the intimate structure of every part of the body, or where-ever bloodvessels are found. A greater proportion of them commence in the skin and mucous membrane, than in any other structure. This is illustrated by cutting off a limb. After the skin is cut through, not much pain is felt in cutting through the other parts.

These little fibres or commencement of the nerves unite together, several of them forming a larger nerve or bundle of nerves; this bundle of nerves frequently unites with other bundles, and all are enveloped in one sheath. In this way all the minute nerves of the body, arms, hands, legs, and feet unite, forming the Spinal Cord that is contained in the back-bone. Between each Vertebra or section of the back-bone, as I told you when speaking of the bones, is a hole, through which these nerves go to unite with the Spinal nerve. The spinal nerve, or bundle of all the nerves of the body, goes up into the skull and there unites in a very intricate and mysterious manner with the brain.

Now these little, minutest fibres of nerves, in uniting together and thus forming the larger nerves, do not mix their substance together, but each fibre

remains separate from the others, each fibre being covered with its own individual covering. In this way each nervous fibre goes separately to the brain. The minutest nerve in the tip of your finger, has its own termination in the brain. This independence of each nervous fibre from the others, you will observe (when we come to speak of the uses of the nerves) to be absolutely necessary, in order that each individual part may make known its wants to the brain without being confused by the wants of other parts.

The Nervous system may be divided, for the sake of description, into three parts. The Brain proper, or that portion of the nerves that lies within the Skull. The Nerves going out from the brain, or what is more proper, the nerves going into the brain to form it; and the Ganglionic or Sympathetic nerves presiding over the involuntary actions of the system.

To commence, then, with the Brain. The brain is contained within the cavity of the skull. The skull is a bony box, made on purpose for the protection of this vital organ, being constructed on the principle of an arch, so as to best resist external violence; and being formed for the same purpose, of two hard tables, between which is an elastic, spongy substance, so that the external plate of the skull may give, when struck, without injuring the internal plate, which would act directly on the brain; the least depression of this internal table on the brain, or the least enlargement of it internally, affects seriously the action of the brain.

The brain is covered inside the skull with three Membranes. One thick hard one externally, called the Dura Mater; a more delicate one under this, called the Arachnoid Membrane, from its resemblance

to a spider's web. Another, or third covering, called the Pia Mater, lies under this; it dips down into all the hollows of the brain, that divide it into parts called Convolutions of the brain. This pia mater is composed principally of bloodvessels, and its use is for the nourishment of the brain, the same as the periosteum or membrane covering the bones, is for the nourishment of the bones. The use of the arachnoid or middle membrane of the covering of the brain, is to secrete or separate a thin, watery fluid from the blood, called Serum, which envelops the brain so as to prevent any friction between the brain and the parts it is in contact with. When this water is secreted in too great quantity, it produces what is called dropsy of the brain, a very fatal disease among children. Rickety children are more subject to it than any others, so that the common expression of a person being a "sap-head," might literally be true. A person can have too much sap in his head for the good of his sense. The substance of the brain is that of a pulpy mass, the same as the nerves going to form it. A thin layer on the outside, has a grayish appearance; internally, constituting a greater proportion of the brain, is a whiter substance. The external or grayish portion is called the Cineritious or bark part of the brain; the internal or white portion, is called the Medullary part. The brain is partially divided into two parts, by a portion of its coverings. These two parts are joined together at the base. The back and under part of the brain, which is much the smallest, is called the Cerebellum, and is supposed to preside over the animal part of the individual. That is, those qualities which man and the inferior animals have in common, such as muscular motion and the

animal passions. The largest part of the brain, the front and upper part, is called the Cerebrum. This is supposed to be the organ of the higher attributes of the mind, constituting his mental and moral part. This Cerebrum is larger in man than in any other animal, in proportion to their size. The brain is divided lengthwise, into two Hemispheres, the upper part of which are separated by a portion of the outer covering of the brain. This partition of membrane is to hold up one half of the brain, when the head is laid on the side, so as to keep the upper half of the brain from pressing on the lower half. These two hemispheres of the brain are further divided, on their under surface, into three Lobes. Then these lobes are divided into still smaller sections, called Convolutions, that are distinguished on the surface by numerous elevations and depressions. The inner structure of the brain is curious in the extreme, being full of layers and strips of brain, of hollows, elevations and depressions, the nature and use of which peculiarities of structure we are entirely ignorant of. In the lower part of the brain is a little soft body, in the center of which, are two or three little, hard substances, like grains of sand. Some have ascribed the seat of the soul to this part, and that the friction of these little grains together, is what starts the spark of life. Future investigation may explain the uses of all the different structures of the brain, but at present, we must remain comparatively ignorant of them. The use of nearly every other structure of the body can be explained on mechanical and chemical principles, but we must confess our inability to explain the physiology of the different parts of the brain in this manner.

The Cerebrum and Cerebellum unite in a peculiar

manner with the Spinal cord after it enters the skull, the fibres on the right side of the cord crossing over to unite with the left side of the brain, and the fibres on the left side of the cord crossing over and uniting with the right side of the brain; so that the right side or hemisphere of the brain has control over the nerves of the left side of the body, and the left half or hemisphere of the brain has control over the nerves of the right side of the body. This is proved by the manner in which paralysis affects the body where the seat of the disease is in the brain. The opposite side of the body is paralysed from that in which the disease of the brain exists. One would naturally suppose that the brain, the center of the nervous system, would be the most sensitive part of it; but strange as it may seem, nevertheless it is a fact, that the substance of the brain has no feeling at all. You can cut off slices of the brain with a knife, without the person's feeling it. But the extension or prolongation of the spinal cord in the skull, called the Medulla Oblongata, is very sensitive; if this is but touched by an instrument, it throws the body into violent convulsions. That the brain is the organ of the mind, there is no doubt, for we see that there is always a correspondence between the size of a person's brain and his mental power. As a general rule, a person with a small brain has a small mind; and one with a large brain has a large mind. You may perhaps point to instances of persons having large heads, that are very weak in the upper story; but if you dissect the brain of those persons, you will find there is some imperfection in the structure of the substance of the brain. This seeming exception does not affect the general rule, any more than a diseased muscle causing a morbid enlarge-

ment and a consequent weakness of the muscle, affects the general rule that the strength of a muscle is calculated by its size. Take a big bow-line for instance, and if every fibre of that line is sound, it will be stronger than the tow-line that is much smaller; but if the fibres of the bow-line are rotten, diseased, it may not be so strong as the tow-line. So a brain may be large, but its structure may be imperfect, rendering it weaker than a much smaller brain, though better constructed. But if the structure of the brain is perfect, the larger the brain, the stronger the mind.

The brain of Cuvier, the great naturalist, that I spoke of in a former lecture, is the largest one on record, weighing four pounds thirteen ounces and a half. A brain may be large, and its parts be perfectly constructed, and still not contain a strong mind. The cause of this is, that one part of the brain may be too large to correspond with the other parts. The person's mind may be strong enough on one particular subject, and not even have common sense on other subjects; in the same way that a person may have a strong arm, enabling him to do the most laborious work that requires only the arm, while his legs may be so imperfectly developed as to prevent him walking an hour. A strong, well-constructed brain has all its parts in the right proportion, enabling it to labor successfully in almost any intellectual field. There is no doubt, I think, that there is a division of the functions of the brain, certain portions being devoted to certain powers of the mind. We find that every other structure and organ of the body has its particular work or function to perform, and why should it not be so with the brain? But I do not believe that, in our present knowledge of the structure and functions of the brain,

that we can tell what particular function belongs to each particular part. We have pretty good reason for believing that our animal nature and propensities are presided over by some power that resides in the Cerebellum. This has been ascertained by experiment on living human brains, and by comparison with the brains of the inferior animals. But to what parts of the cerebellum the different animal feelings and passions belong, I candidly believe we do not know. We have reason to believe, by observing the growth of the Cerebrum, to be in proportion to the enlargement of the mind, by comparing the sizes of different cerebri of different individuals, and finding that those with the largest cerebri have the largest minds, and by a comparison of the cerebri of different animals, differing in the amount of intelligence they possess; I say, by such a course of comparisons and reasonings, we are led to the belief that the cerebrum or larger portion of the human brain is the organ of the mind or intellect—that here is where the thinking and willing principles of our nature reside and nowhere else. Take the cerebrum away and you are no longer capable of thinking or reasoning. The cerebellum might enable you to live like an animal, having all its tastes and desires; but you would have no intelligence and would be incapable of improvement. You would be worse off than the horse, which does have a small cerebrum.

Phrenologists have undertaken to locate the different powers of the mind in particular parts of the brain. They locate these qualities of the mind going from the outside or circumference of the brain, toward its center. Each of these portions of the brain, say they, comes in contact (the membranes of the brain

only intervening,) with the skull, and corresponds with an elevation of the skull over the part, which they call a Bump; in this way making these elevations over the surface of the skull an index to the development of the portions of the brain lying under them. So that all we have to do, to measure a person's mental powers, is to measure his bumps. However well satisfied phrenologists may be in the correctness of their system, I never could bring myself to the belief that our knowledge of the brain was sufficient to allow of the location of the different qualities of the mind to individual parts; and much less to warrant us in locating these qualities in the external portions of the brain, and still less yet, in ascribing a raising of the tables of the skull to be in proportion to the development of a particular power of the mind. I should think, that if particular qualities of the mind have their particular parts of the brain, these parts of the brain would be as likely to be located in the internal structure of the brain as on its superficial structure; and judging from the singular and complicated structure of the inside of the brain, that if a very delicate and elaborate endowment of the mind would require a very delicate and elaborate organization for its instrument, that we should find these complex instruments in the internal structure of the brain, rather than on the external surface, judging from the appearance of the different parts of the brain; for, as I said before, it is all guess-work; that we have no good reason for locating any particular part of the mind in any particular part of the brain, judging from the appearance of its structure. And then, even supposing that the different parts of the mind were actually

located in regular sections of the external part of the brain, having their boundary-lines fixed by law, the same as the boundary-lines of each township are, the Phrenological system is no more certain than before, for the prominences of the skull do not correspond invariably with the development of that part of the brain directly underneath; for some of the bumps are caused by a thickening of the skull, for the better attachment of muscles; while other bumps are caused by a separation of the tables of the skull, to form a cavity between them, as is the case in the Frontal Sinuses, the outer table bulging outward forming a bump, and the inner table bulging inward, causing a deficiency instead of an increased quantity of brain underneath the bump. So that just in proportion to the largeness of the bump externally, is the want of brain beneath it. I may be too skeptical on this point, but I candidly believe that this Phrenology is a carrying the thing farther than our real knowledge of the brain warrants.

In the formation of the Nervous system of man there is a striking similarity between it, at its different stages of development, and that of the different orders of animals. The center of the nervous system, in the lowest orders of animals, is merely a cord without any enlargement at any point. In animals a degree higher in the scale of life, in the lowest fishes, this cord becomes slightly enlarged at five different places at one end of the cord, resembling little knots; these five pairs of enlargements are called Ganglia. In the higher order of fishes, the two first of these knots or pairs of ganglia seem to be fused into one, leaving only three pairs of ganglia or knots. As we ascend a step higher in animal life, as exhibited in the cat and dog, for

instance, we find first, a single ganglion or enlargement of the spinal cord, the cerebellum, and then, immediately following, four ganglia; on removing the covering of the middle of these ganglia, you will find two pairs of ganglia inclosed in the sheath, making out the five pairs of ganglia that we find to exist as a nervous center in all animals above the lowest order; which lowest order has but a cord without any enlargement for its nervous center.

Now let us examine the development of the nervous system in man, from the first sign of a nerve to a full grown brain. The first indication of a nervous system in a human being, in the first periods of infancy, is merely a pair of small cords. The infant, at this stage of development has no more life than the lowest orders of animals, in which we find the same kind of a nervous system. As the infant becomes more developed, five little knots or ganglia are noticed on each of these cords near one end; they are not disposed in a straight line, as in fishes, but in a curved direction, to accommodate itself to the future cranium. The infant, at this period of development, has the life of a still higher order of animals — the higher order of fishes; and as these five pairs of ganglia become more united, resembling the nervous system of the highest order of animals, as the cat and dog, the infant has the life and intelligence of those animals. Then, finally, as these original germs of the brain enlarge and become intimately united together, we have the human brain, superior in its size and in the delicacy of its structure to the brain of any other animal, and, as a consequence, we have an intelligence connected with this superior organization, superior to the intelligence of any other animal.

We find the brain thus organized in the child, but its organization is not yet perfect, for the brain continues to improve in structure by becoming more firm and distinct in its different parts, and larger as the child grows up to adult age. This improvement and strengthening of the brain continues through life, if its possessor lives in such a manner that its energies are not crippled by connection with a weakened body. There is no need of this dotage or second childhood—it is not natural. If men lived as nature designed they should, the mind would become stronger to the last.

In ancient times, when men lived more naturally, old age was but another name for wisdom; but now-a-days a man is kicked off the stage of action at fifty. We have our retired lists of ministers, soldiers, and politicians — a polite system of bribery for the recipients not to expose their weakness. But this should not be so; a man's mind should be stronger at seventy than it is at thirty; it should be stronger at eighty than it is at seventy; for I believe that the mind was designed to progress continually to the end of the chapter. And then, I believe, that when it leaves this chapter and commences another in a higher state of existence, it will continue to progress. And who is prepared to say but that it will go into a still higher and higher existence through all eternity, as its powers become more and more developed?

No wonder that men's minds grow weak in old age, in modern times. The course of life we live, is the one best calculated to weaken the energies of our brain; and it is a good thing that our Creator has taken compassion on us and shortened our lives, for if we were permitted to live a hundred years, as in

old times, we should have no mind at all to start with in the next world. We are all of us living in such a way as to weaken and finally destroy the integrity of our brain, and, as a consequence, our mind; for you must bear constantly in recollection, that the brain is the organ of the mind, and whatever affects it affects the mind, and that the mind is always in the same condition as the brain. If the brain be small and weak, the mind will be also; if the brain be injured, the mind will be; if the brain be diseased, the mind will be diseased. Now, we are all of us, continually using practices and articles of food and drink to stimulate the brain to inordinate action, or to bring it below an ordinate action—to deaden it, as it were, and to change it from a natural to an unnatural action, merely because it gives us a morbid pleasure for a short time, to be followed, when the excitement goes off, by a proportionate want of pleasure.

What are these practices you ask? Too great exercise of the brain, and exercise in an unnatural way. One can injure and wear out his nervous system by too constant and too severe mental application. You see this illustrated in what are called precocious or forward children—children with large brains—too large for the size of their bodies. Their aptness in learning induces their parents and teachers to stimulate them to inordinate exertion; they make rapid progress for a while, but finally their nervous power gives way. The nourishment that ought to have gone to the support, growth, and strengthening of the other parts of their bodies has been entirely taken up by the brain; and the result is, that the physical organization of the individual is not properly balanced, the brain being too large for the other parts of the system. It is like

putting a powerful engine, calculated to drive a large steamboat, into a canal-boat; its workings will shake the little craft to pieces. And we find that these precocious children do not make as smart men and women as children that are not so forward. Instead of encouraging such children to increased exertion, they should rather be held back, so that the other parts of their bodies may keep pace with the development of their brain.

Particular pains should be taken in giving such children plenty of exercise in the open air. As a general thing they have not the disposition for bodily exercise as other children, and will not take sufficient, unless encouraged in it. But these precocious, forward children are exceptions. The majority of children, instead of requiring a curb and stiff rein to hold them back, require the spur to urge them on. There are occasional cases of adults who study too much for the well-being of their nervous system. An inordinate ambition for intellectual glory is generally the incentive. This burning of the midnight oil, for the sake of glory, as a general thing, is not profitable—*don't pay*—for, at the same time that we are burning out the midnight oil, we are also burning out the oil of life. The mind is, however, over-exerted oftener in other than purely intellectual pursuits. The studying up plans to get rich, and the constant mental anxiety in carrying these plans out, consume more of the oil of life than the labor for intellectual glory: the merchant, for instance, whose mind is on the stretch from morning till night trying to convince old Mother Particular that this piece of calico won't fade, and that neighbor-so-and-so sells the same at twelve cents a yard while he sells it at eleven and three-quarters; in

trying to buy Deacon Doubleday's corn, who wants just three-quarters of a cent a bushel more for the corn than the merchant gets for it, with the privilege of the rise of market for the next six years; in trying to make 'Squire Woolhead satisfied with his account, there having been three sticks of candy charged eighteen months ago, whereas 'Squire Woolhead thinks there was only two sticks got, he having but two candy children at that time. And then the burning of life-oil that takes place in making collections and in meeting his obligations. It is ten times more mental exercise than a man ought to have, and it will surely wear out his nervous system.

All occupations where the brain has to do more than the body, are liable to produce nervous exhaustion. The too great exercise of the passions and emotions, as in excessive anger and grief, will wear a person's mind. Excessive passion, or grief, or fear, is, perhaps, more exhausting to the mind than any other mental exercise, and would soon prostrate it if kept continually under their influence. But the passions and emotions do not last long. We frequently work ourselves into consuming passions, but the fire don't last but a few hours and then goes out of its own accord. Our grief is quenched by a flood of tears. A wicked and criminal way of living destroys both the intellectual and moral part of our mind. Honesty is the best policy, so far as the well-being of our brain is concerned, at least. A confidence and implicit reliance in our Creator, believing he has made and directed everything for the best, gives the mind a contentment that goes far toward the preservation and increase of its powers. The most fruitful source of debility of the brain, however, comes from

its connection with the body, being affected by the ills and improprieties of all parts of the body.

Our food is not the right kind for the good of the brain—it is too stimulating—it excites the brain to irregular action. The peppers, the vinegars, and spices, and jellies, and concentrated mixtures of various kinds, are the very things to make the brain irregular in its action and imperfect in its structure. For the brain is formed from the blood, and the blood is formed from the food, so that the brain cannot help but be influenced by the nature of our food.

Our drinks are even more deleterious to the brain than our food. Water, pure water, unmixed with anything else, was undoubtedly the drink our Creator designed for us and for every other animal, as a drink; but it has become now so that we seldom drink water alone; it must be mixed with something that will excite the nervous system to an unnatural action—with tea or coffee, or some kind of spirits. Now there is no nourishment, or the next thing to none, in tea, coffee, or spirits. They are purely stimulating to the nervous system. They do not add to the power of the system, but merely produce an irregular action of the powers of life, causing them to be more active than natural, while under the influence of their stimulus, and to be less active than natural when the stimulus has gone off. Tea, coffee, and spirits act as agents for the nervous system to borrow strength from the succeeding hours, and when pay-day or pay-hour comes, the system finds itself just as much short of natural strength as its agents borrowed for it; and it will be nervously embarrassed until this loan is paid up, and the system is again out of debt. But generally we pay up this loan by employing these agents,

tea, coffee, or spirits, to make another loan. Now these loans all draw interest, consequently, we have to increase these agents, or their power, every time we use them, if we wish to keep up the excitement. And finally, we run our face to such an extent, that we drain the bank and it has to suspend. Then we must dismiss our agents, go to work naturally, and recover our powers, or undergo complete bankruptcy and prostration of our nervous system. The best way for us, then, is to dismiss these agents and depend on the natural resources of our systems for capital. Follow John Randolph's rule — pay as we go — and not run our brains on a fictitious capital.

There is another set of artificial agents pretty generally in use in this country, for the purpose of keeping the nervous system under an unnatural excitement. I mean the different preparations of tobacco and opium. These act directly on the extremities of the nerves, when taken in the mouth in a solid form or in the form of smoke, or when taken in the form of snuff. They act on the same principle that tea, coffee, and spirits do; that is, as agents to borrow strength—they do not generate any strength themselves.

Another view of the manner in which these artificial stimulants act on the nervous system, is taken by some writers who view them as poisons. They say that the excitement they produce in the nervous system, is an effort of nature to rid the system of these poisons. This much is certain, that the active principle of most of these artificial stimulants, is rank poison, and if given in too large quantity to a system unaccustomed to their use, it will produce death.

These artificial stimuli, such as tobacco and ardent spirits, are taken up into the circulation after they

produce their first impression on the extremities of the nerves, and become part of the blood; now the brain is nourished by the blood, consequently these deleterious agents become part of the brain, and impart to it their baneful influence. If you dissect the brain of a person who has been indulging freely in the use of alcoholic drinks immediately before death, you can smell the alcohol in the brain.

That these substances enter into the blood, any of you can become satisfied by smelling the breath of a person who uses them; this taint does not come from the mouth, for you can introduce them into the stomach by pouring them through a tube, so that none of the substance shall touch the mouth, but the breath will smell of the liquor or tobacco just the same. It is because they enter the blood, and while the blood is going through the lungs, Nature does her best to throw off these enemies to the system by the breath. This is the reason why the brains of habitual drunkards become so dead and torpid. The alcohol changes the structure of the brain, making it harder and less active. If you take the brain and keep it in alcohol a while, you can see with your own eyes the effect alcohol has on the brain, and, consequently, on the mind. But I don't know as it has any worse effect than tobacco, or opium, or coffee, or tea, if these articles are used in the same excess and concentrated form that alcohol is used.

It is my candid belief, that each one of these articles, tea, coffee, or tobacco, does more harm to the human family than alcohol, for the reason that where there is one person that uses alcohol to excess, there are a hundred that use tea, coffee, and tobacco; and those who use tea, coffee, or tobacco, do it continually,

keeping their systems under the influence of them all the time; while those who use ardent spirits to excess, as a general thing, have periods of abstinence from its use, giving the system a chance to regain its healthy condition. Now I contend, that it does a person's system less harm, to get gloriously drunk once in a while—drunk enough to make one loathe the sight of liquor or food for two or three days after—I say it does the system less harm than to keep it continually under the influence of the more mild stimuli.

As to opium, its bad effects on the one who uses it habitually, are worse probably than that of any other artificial stimulant. The pleasurable effects that it produces, temporarily, are greater, consequently the debt that the system has to pay afterward, is greater than that after any other stimulant in use; and the habit of its use seems to be harder to be overcome than any other bad habit.

LECTURE VI.

THE NERVOUS SYSTEM—(*Continued.*)

How then are we to have a sound and strong brain? First, by exercising it in a proper way, so that it may be growing stronger continually; for I believe that our brain should grow stronger to the end of our lives. Secondly, by keeping the whole body in a healthy, strong, and natural condition, so that the brain, in its connection with the other parts of the body, may not have to suffer from their defects or improprieties.

To educate the brain to the best advantage, so that it may acquire the greatest possible strength, the mental training must commence early. In early childhood the brain is soft, and has more of a singleness of action. The different parts of the brain, to which the different faculties of the mind belong, have not become developed, or at least have not become distinct in their action. In childhood, the brain, and consequently the mind, is in a chaotic condition. The soft clay, if I may use the expression, is there; it is roughed out into something of a shape, like the soft ball of clay that the potter puts on his wheel to turn out the elegant vessel from; but this soft, imperfect mass has to undergo a long process of finishing, and baking, and glazing, and polishing, before it assumes the shape of the well-formed and perfect brain. As much depends on the general shape the potter first gives to the lump of clay, while it is soft enough to be pressed into any shape, as to the character of the

future vessel he designs to make from it; so, also, much depends on the first shape that is given to the brain, as to its future character. If the potter first models out a milk-crock, all the sticking on of spouts and handles, and covers, and all the subsequent polishing will not make a perfect tea-pot of it; it will cost him more labor than to have made two tea-pots from the start, and will be a botched-up affair after all. Precisely so is it with the brain and its mind; you can give it almost any character you wish, according to the circumstances with which you surround it at first. The circumstances that surround the mind when it is in its formative stage, will affect its shape the same as the mould into which you pour the melted iron, will affect the shape of the casting. You might just as well expect to get a tea-kettle by pouring melted iron into a plow-point mould, as to expect to form a mind different from the circumstances with which it is surrounded. Something, as a matter of course, depends on the quality of the material of the infant brain. There is a difference in the quality of brain in different infants. The pulp or substance of the brain itself is of better quality in some than others; the same as there is a difference in the quality of Swedish iron and common bar-iron; or between the material our common stoneware is made of, and the material the beautiful china-ware is made of. This difference in the quality of brain is generally hereditary; that is, it comes from the peculiarity existing in the brain of the parent or parents. The quality of the brain of the child will be like that of the parent. No fact in relation to the brain is more certain than this. There is not one among us but has noticed that the children of weak-minded parents are also weak-minded. Whenever

you find a family of weak-minded children you will find a parent or parents in the same fix. Sometimes you will find in the same family weak-minded and strong-minded children. In this case, there is a deficiency in only one of the parent brains. Starting then, with the brain of the child that is supposed to be of ordinary quality; that is, not of the best quality or of the poorest quality, we find it in a soft, imperfect condition; its mind (if it may be said to have a mind at all), as a consequence, in the same imperfect condition. How does this chaotic mass of brain become perfectly organized? How is the mind formed? The first indication of a mind in a child is manifested in its crying and nursing. We call this instinct. The young of all animals have the same manifestations: what this instinct is, we do not perfectly understand; what causes its development before any other powers of the mind we are unable to tell. This is one of the facts that physiology has not been able to explain. At this period, I believe there is no more mind in a child than there is in a young colt; but there is the material to make a mind with; the pulp of the brain, which does not exist in so great quantity in the colt. How then is the mind formed? It is formed first from the exercise of the senses; of sight, hearing, smell, touch and taste. When a child first notices a candle, it has no idea what it is; it must learn what it is by the senses. It looks at it frequently, and for weeks and months before it forms an idea of its appearance; but the idea it forms of a candle would be a very imperfect one, if it only knew it by means of the sense of sight; it could not distinguish it from the picture of a candle. It must form an idea of its shape and feeling, by the sense of touch. It does not know

that the flame of the candle will burn and produce pain until it sticks its finger in it; after burning its fingers a few times, it gets an idea of this quality of the candle. It has no idea of the taste of the candle, until it puts it in its mouth. Its ideas of sound are just as imperfect, until the organ of hearing has experienced all kinds of noises, and experienced their effects frequently, so as to enable it to distinguish one kind of sound from another. By hearing the mother's voice more frequently than any other sound, it gets an idea of that first. By seeing and feeling her face oftener than any other face, it is able to form a definite idea of it so as to distinguish it from any other face. In this way our first ideas of external objects are formed. These ideas do not exist in the brain until they are formed there by the brain coming in contact with these external objects, through the medium of the senses. A person who is born blind has no idea of color or the appearance of objects. One who is born deaf has no idea of sound. This is the reason why all who are born deaf are also dumb. It is not because their vocal or talking organs are imperfect, for they exist in a deaf and dumb child as perfectly as in one who is not deaf and dumb. It is because they cannot hear their own voice; they have not the least idea of the nature or use of the voice. And when they make a noise, as some of them do, they are not conscious of making a noise. They get in the habit of using the muscles connected with their chest and vocal organs under certain circumstances, and putting these muscles in operation, produces a sound which we hear but they do not. And so the child and the colt go on getting ideas of external objects—the colt about as fast as the child. But after a while, the

child begins to use these ideas—compare them the one with the other—and here is where the child advances ahead of the colt. The colt has no organ, or next to none, to enable it to use these ideas that it has obtained of external objects. But the child has an organ, or the material to make the organ with, that will enable it to compare these ideas together and use them in different ways; this organ is the Cerebrum, and the using of these ideas of external objects, that have been obtained by means of the senses, is what forms the mind. These first ideas got by the senses are like the brick, and stone, and timber in architecture, with which the building is constructed; they are the materials with which the mind is constructed. When the cerebrum first begins to make itself manifest, by putting these original ideas together in various ways, and thus forming comparisons and reasonings, and laying the foundation for a mind, it leaves the colt, which remains where it was without farther progress, because it has no part in its physical constitution that is capable of being the organ of the mind. But the child's cerebrum is capable of being improved indefinitely, with which it can form a mind, and go on enlarging and strengthening its mind so long as the being lives.

When the brain first commences exercising this new power—that of the mind—is the time when the education of the brain should commence. Before this, not much can be done but to bring the child in contact with the external world by means of its senses, so that it can get its first ideas in this way. All you have to do is to let the child paw, and feel, and scratch, and see, and hear, and smell, and taste as much as it can with safety. But when its mind shows itself, you

cannot use the mould, whose shape you wish the mind to assume, too soon.

And here I cannot help noticing a certain religious doctrine that was drilled into my head when I was a youngster: that of human depravity, which sent children not a span-long to hell for the sins of their parents. I was taught to believe that the soul was that part of our life to which the thoughts, the desires, and the volitions or will belonged; and that it was the part that lived after our bodies died, and was answerable for the acts of the body; that it was our spiritual part; in a word, that it was our mind. Now physiology teaches me that in the first periods of infancy, there is no mind. It teaches me that the mind does not exist until it is formed by the exercise of the senses, and by the reasoning powers of the brain. How, then, can the reasoning part of an infant, its mind—its soul, if you please to call it so—be answerable for good or evil, or be answerable for anything at all, when it does not exist? The child does not know good from evil—does not even think any more than the colt does of the same age, until its mind has been formed in the manner I spoke of. You ask me then, very naturally, what becomes of the spiritual part of the infant dying before the mind is formed? I answer that I do not know, nor am I anxious to know. I believe as sincerely as any one, that there is a creator of all things. I believe that Creator is infinitely wise and just. I am satisfied of this from studying his works. I find them perfect, and consequently I have implicit confidence that the spirit of the infant, as well as that of every other living being, will be dealt justly with. And I further think there is no need of prying

into the business of the Almighty in relation to the future, to see whether he gives us all justice or not.

My idea in reference to a future existence is this: that it is a continuation of this existence; that we take with us when we leave this state of existence, the same spiritual part that we have here; that the spiritual part of our nature is governed by fixed laws, the same as the bodily part, and that a violation of these laws brings its own punishment, the same as when we stick our hand in the fire, thus violating the laws of our body, we suffer punishment. So when we live wickedly, the effects of that wickedness is our punishment, we experience some of the effects in this world; but I believe that we still continue to experience those bad effects hereafter until we cease violating the laws of our nature. What becomes of the spirit of an infant dying before it has a mind I cannot imagine, or how it can acquire those first ideas necessary to the formation of a mind; whether it goes into some material organization elsewhere, to form those ideas, or whether it can progress hereafter without them, is a matter resting only in the bosom of the Almighty.

You begin to think that I have got off from the track, and have commenced preaching. You can call it preaching, or lecturing, or anything else you choose. I prefer looking into these matters in a natural, common-sense way, to surrounding them with all the mystery and superstition of bigotry.

We will commence back again where we left off before flying off on the theological side-cut. This flying off on to side-cuts, leading to some other intellectual region, is a natural fault of mine in engineering

the train of thought; if the switch is the least turned, so as to favor the digression, off goes the train.

When the mind first begins to show itself, endeavor to surround it with circumstances best calculated to favor its full and perfect development. Show natural objects to the child first, and explain their construction and uses. Encourage the child in asking questions, and always answer them truly. It is by this familiar way that the mind acquires its first strength. If you show me an intelligent child, I will show you a parent or parents that talk with that child as with an intelligent being, taking a pleasure in answering its questions and in explaining things that it does not understand. You might as well answer the child's questions in the first place, and make the matter as clear to its mind as possible; you will gain time by it, for if you put the child off with "O don't bother me!" the child will bother you, and continue bothering you, perhaps a hundred times, with the same question, until it is satisfactorily answered. It is much better to educate a child in this familiar way, during the first four or five years of its life, than to send it to school to have reading and grammar drilled into it before it has mind enough to comprehend them. This is the time that the disposition and moral character of the individual, to a great degree, are determined. If a child is continually teased—his combativeness excited—the part of the brain devoted to that faculty will grow too fast and will fix the character of the individual as a contentious, quarrelsome person. It will require a great deal of self-denial and long practice to change this character after it is once formed. If, on the contrary, you discourage the exer-

cise of this faculty, and encourage the exercise of its opposite faculty, benevolence, the disposition of the in-individual is almost sure to be of a different character—he will be mild, peaceful, getting along with his fellows with much less difficulty, than if the opposite disposition had been encouraged in him.

No truer simile ever was written in reference to the mind, than this: "Just as the twig is bent the tree's inclined." Just as you shape the young mind, so will it be in after life. It will have a tendency to keep on in the same direction through life, that you give it when it first starts. A man is courageous or cowardly just as his parents make him when a child. If you make your children mind you by means of "black-man," or "booger," or some other hobgoblin, they will be afraid of hobgoblins through life. The reason that the ancient Spartans were such brave men, was, that their parents educated or encouraged the growth of this faculty of courage from infancy. They would set their children on the eaves of their houses, as soon as they could sit alone, to make them fearless.

During this period of childhood, if any particular taste should be noticed in the child, such as a taste for the use of tools, or farming, or trading, or speaking, or singing, that taste should be encouraged, not stimulated beyond its powers or inclination, so as to produce disgust, but let the child gratify its taste as long as it wishes to. By thus noticing the direction the mind naturally takes, you will find out what pursuit the child will best succeed in; for a person must have a taste for a pursuit or he never will accomplish much in it. If the child do not seem to have any strong predilection for any particular pursuit, and you have a preference for one, place circumstances around him to

develop a taste for the pursuit you wish him to follow. If you wish him to be a farmer, give him a hoe and a strip of ground to work; take him out in the fields and among the stock; give him a calf, or a colt, or a lamb, and encourage his care and love for it. In this way you will form in him a taste for agriculture. If you wish him to be a mechanic, give him tools and materials to work with. If the child be a girl, encourage a taste for doing housework; for this must necessarily be a part of her legitimate business, no difference what sphere she may be placed in.

You need take no thought for your boy, as yet, if you would wish him to be a professional man. Give him a physical education first; let him get common-sense ideas of common things that surround him; and then, as his mind grows stronger and is able to investigate and understand them, let him study books. It is time enough to put a child in books when he is five years old; he will form just as good a mind, and probably better, than if he commenced sooner.

When you do put children in books, let them study but a small portion of the day—say, two or three hours—and exercise out doors the balance of the day; their minds and their bodies will improve better than if you confine them twice that length of time to books. In training the brain, as in training the muscles, strength is to be acquired by alternate exercise and relaxation, according to the strength of the part.

When the child grows up to be a youth and has acquired a knowledge of the rudiments or first principles of knowledge, such as reading, writing, composition—which includes grammar, arithmetic, geography, chemistry, natural philosophy, astronomy, the science of government, and above all, physiology—he is then

prepared to select the pursuit he intends to follow through life; for every one, however rich he may be, ought to have some occupation. Without occupation it is impossible to enjoy life. The wish for independence as a means to enable one to be idle, is the worst wish for your happiness that you can make. In a youth selecting his business, he should select that business which he likes best; for, if he is satisfied, he will continue to like the business as he practices it.

Never select a business merely as a means of getting rich; if you follow a business merely with this object, without experiencing any pleasure in the pursuit of the business itself, you never will derive the proper enjoyment from it. Your principal pleasure should be in the labor of carrying it on, and the pleasure and convenience the business affords others. If you follow farming, take a delight in it; cultivate your land to the best possible advantage; study the business as a science; endeavor to have the best implements, the best stock, the best varieties of grain and fruit. Here is where your greatest pleasure will be. By farming in this spirit, you will enjoy yourself, and be contented, but if you farm merely for the purpose of making money, you will not derive a-tenth part of the satisfaction from the business. You will live in constant dread of a failure of your crops, and will not take that pleasure in the labors of your farm. To a farmer who likes the business, the labors of carrying it on are an enjoyment. So it is with every other kind of business. If you are a mechanic, glory in the calling; try to excel in your particular business. Aim to be No. 1, in whatever pursuit you follow. If you are in public business, consider yourself an agent for the community in which you operate. Consider

it your duty to be prepared to perform those duties properly that your patrons expect of you. If you undertake to supply a community with any particular article or articles, consider it your duty and your pleasure always to have such articles on hand, and of a satisfactory quality, so that your patrons may not be disappointed. When a person becomes discouraged and discontented with his business, and there is a probability of the business always being disagreeable to him, the sooner he quits it the better; for it is seldom that one will succeed in a business he does not take a pleasure in.

These remarks, in reference to the culture and occupations of the mind, are but natural inferences from a knowledge of the structure and nature of the organ of the mind, the brain.

The different powers of the mind are located in the different parts of the brain. Now, if you wish to succeed or excel in any particular pursuit requiring the exertion of any particular faculty of the mind, and consequently any particular part of the brain, you must exercise that particular faculty of the mind repeatedly, and for a long time, in order to develop its organ in the brain. This is the way one man becomes more proficient and skillful in one kind of business than another, because he exercises, and consequently enlarges and strengthens, that part of his brain which is brought into use in the practice of that particular business. Skillfulness in mechanical pursuits is generally supposed to reside in the development and education of the muscles; but as I said before, the muscles are merely the tools of the brain; they are large when the brain uses them much, but in the construction of intricate and beautiful pieces of workmanship it is the

brain that directs them, and to whom the credit of the work belongs. All of you that have ever had any blacksmithing done, are aware of this fact. There are some blacksmiths who have learned their business in the same way that a horse is learned to work in a tread-mill—by rote, without being told, or without having inquired into the whys and wherefores of their business. They hammer their whole lives out without doing a single skillful job. While there are other blacksmiths who have not done half so much hammering, but more thinking, that seem to know just how to go to work to do you a job as you want it done. This shows the necessity of taking pains to give an apprentice a theoretical, as well as a practical knowledge of his busiuess. If a carpenter sets an apprentice to sawing or boring without telling him what it is for, and without encouraging him to learn so that he can become a skillful workman soon, it is like setting a dog to churning on the old-fashioned churn-wheel—as soon as his master's back is turned, the dog's head is turned also, and the churn stands still; so it is with an apprentice that is learned mechanically only—he has no interest in his work—the sawing and boring operation are in reality a saw and a bore to him. But as soon as you make it interesting to him by explanation and encouragement, he progresses much more rapidly, and is of much more use to his employer. The strengthening of a particular faculty of the mind, by a gradual enlargement and strengthening of a particular portion of the brain, by a proper exercise of that portion of the brain, shows also the necessity of a person sticking to one kind of business, if he wishes to excel and succeed in that kind of business. We see the folly of men leaving a business that they have educated their

brain for, and in which they are doing well enough, to go into a business that their brain has had no training for. As a general thing, they make a failure of it. For instance, a substantial farmer, who has got everything fixed to his notion—who has got things in this favorable condition by a long practice of agriculture, in which he is thoroughly skilled, and which he is capable of carrying on skillfully and profitably: he takes it into his head that he can do better merchandising—goes into it. Things go on swimmingly for a while; he despises his old dirty business. He takes his wife's home-made linsey off, and makes her wear silk. His hands, that had become large and strong in holding the plow and swinging the ax, he covers up with gloves. He wonders how he should have missed his calling so long. But after a while, he finds his stock gone; no money to buy more with, and a pack of drummers dogging him in full blast. He can't understand how all this comes. He commenced business with two or three thousand dollars; he has made thirty-three per cent. on his goods; he has not been very extravagant, but still, he is out of pocket; he is troubled with that very disagreeable complaint, called the "shorts."

I will tell you how this comes. He has undertaken to play merchant with an agricultural brain. There is no use of your telling him this, for he won't believe you. He refers his ill success to a change in the times—to the rascality of his customers, and all that sort of thing. The true secret of the matter is that he is a greenhorn in the business, and the sooner he throws away his gloves, takes hold of the plow-handle, and gets out of the scrape generally, the better it will be for him.

As a man's intellectual or business character is formed by a continued exercise of that portion of brain to which that portion of the intellect, or that branch of business belongs; which exercise develops, enlarges, and strengthens that portion of the brain, and consequently, that portion of the mind; so also is his moral character formed by a continued exercise of the portion or portions of the brain to which the moral faculties belong.

If you continually tease and plague a child; encourage him to contend and quarrel, and thus to bring into continual exercise that portion of the brain to which this quarrelsome faculty belongs (wherever it may be placed; phrenologists call it combativeness), that portion of the brain will gradually become stronger in that particular faculty, until a quarrelsome disposition becomes a fixed trait of his character, and cannot be changed except by a long practice of the better faculties, and a disuse of the quarrelsome one, until that portion of the brain to which it belongs, is reduced in size and power to a proper standard.

If you encourage in a child the exercise of the musical part of its brain (the part that phrenologists call the organ of tune), you can make a musician of almost any child. All that is necessary is to enlist the will of the child to engage in it. There is not so much difference naturally in the talents of children as is generally supposed. Take a healthy, well-formed brain in its infancy, and you can make anything you please of it, or rather, of its owner; you can make a mathematician, a mechanic, a musician, an honest man, or a rascal of him. The future character of the individual depends entirely on the direction that is given to the will of the individual on the start. It is

like the direction that a ball takes when it is shot from a gun, it may hit objects that will make it glance, but the general direction of the ball will be the same.

There is in every intelligent being a mysterious power called the Will. We imagine it to be connected, in some way, with the mind and its organ the brain; but how this connection exists, or how it influences the powers of the mind, we know not. It is the ruler or governor of the mind, of the different parts of the brain, and of the voluntary nerves. It is not despotic in its sway; although it rules over the nervous system it seems to be influenced or swayed in its government by the very parts over which it rules. Its power is to the body what a limited monarchy is to a nation. Although the head of government gives the general direction, and originates or suggests the necessary improvements and measures, the operations themselves are perfected and carried ont by organizations and departments constitnted expressly for that purpose.

It is the will that directs any particular part of the nervous system to be exercised. If there is a necessity for a certain muscle to be contracted or relaxed, the will sends an order along the nerve going to that muscle, and the muscle contracts or relaxes according to the wish of the will. If we wish to speak, the will sends orders to a variety of muscles about the face, mouth, throat, neck, and chest, to contract or relax to produce the required sound. If we wish to calculate mathematically, the will directs the nervous energy to be concentrated on that portion of the brain devoted to this faculty of the mind, and the process of calculation goes on. Now, in the development of any particular part of the muscular or nervous system, which is accomplished by a proper exercise of the part, it is the

will that directs the part to be exercised. This brings us to the practical point at which we wished to arrive—that, in order to educate or train a child in any particular calling; in order to develop and improve his moral or intellectual faculties, you must induce the will of the child to apply its energies in that direction. Now when this general direction is once given, and the organs of these faculties become partially developed, they have a direct power or tendency to influence the will in their favor. They have the power to become the pets or favorites of the will.

As you often see illustrated in the social world, a monarch will take up an insignificant being from the rabble, as the king of Bavaria did Lola Montes, for instance, and by cultivation and favor, become influenced in turn by this creation of his own. So if the will directs the energies of the nervous system on any particular part of the brain, and thus encourages the growth of the organ, and the development of that faculty of the mind which belongs to that part of the brain, after a while this faculty acquires a supremacy over all the other faculties, and monopolizes the favors of the will entirely.

This is the way, then, that any particular talent is developed. This is the simple manner in which superiority in any human endowment is obtained. So you see it rests in your own will to make of yourself what you choose. Do not blame your Creator for inferiority in any respect: he gives you the batch of brain in a soft, pliable condition. He gives you the will to shape that batch of brain into just such a form as you choose; in other words he constitutes you the maker of your own intellectual and moral character. How necessary it becomes then, in parents, to direct

the wills of their children in the right way. After the character of the mind is once formed, it is no easy matter to change it. No entire change of character can be formed except as its organ or instrument, the brain, is changed; and this requires a long and patient exercise of another set of organs of the brain, and a constant restraint on the organs that have already become developed, so that they may grow less from disuse.

A man's character cannot be changed in a day, any more than the muscles of a blacksmith's right arm can be much reduced in size in a day. The man's character can be changed no faster than the parts of the brain to which his peculiarities of character belong can be changed.

And here permit me to make a remark in reference to a doctrine that most all evangelical churches adhere to—the doctrine of human depravity and of the necessity of a sudden change of character before a man can be good—a sudden transition, as it were, from moral darkness to heavenly light. I have had some experience in this matter, and therefore can speak feelingly on the subject. I was brought up, from my earliest childhood, in the belief of Christianity. I was taught to pray and read the Scriptures daily. I was taught to believe in, and obey the precepts of the New Testament implicitly. The moral part of my brain was formed in this fashion, and it was impossible for me to believe any other system, or to change my moral character unless the structure of that portion of my brain underwent a corresponding change, by a due course of training in a different manner. It was always my intention to join the Presbyterian Church, the one my parents belonged to. When I was sixteen

years old I applied for admission. I did it of my own free will, being away from home at school at the time, and among strangers.

The Presbyterian Church sets apart a particular day before communion, for the examination of applicants for admission, to see whether they are sufficiently orthodox. When the minister came around to me, I answered all the questions satisfactorily, until he asked me the question whether I could point out any particular time in my life that I had experienced a sudden change of character, from one of depravity to one of regeneration. I told him my history; that I had always been brought up in a Christian spirit, and consequently I could not point to any such time. I was rejected.

I relate this incident to illustrate to you the physiological fact that our moral character is the result of a peculiar training of the different portions of the brain. Since I have come to study physiology, I am convinced the more that I was right; that it was physically impossible for me to have changed suddenly my moral character. Now it seems to me that this is much the most plausible view of the matter—the most in accordance with Nature. This view of the matter would give us more sympathy and forbearance with those who are trying to change their character for the better. We should not expect a person who has made a will to reform, to be perfect at the start; we would be led to overlook his occasional errors, that his old, vicious brain is constantly prompting him to commit. By using this forbearance with him until he is able to change the nature of his brain, by a long and continual practice of virtue, we make a reformed man of him indeed. Every one, I think, must see the

plausibility of this who has witnessed our revivals of religion, and who has witnessed the lamentable backsliding that takes place among three-fourths of the converts. It all comes from the erroneous and unnatural doctrine that a human being can change his character without changing the part of the brain to which the peculiarities of that character belong. When the penitent sinner is brought to the mourner's bench, it is only his will that is operated on by the persuasions of the preacher; he resolves to change his character, in the same way that a man with a swelled leg comes to a physician and resolves to have the swelling removed. Now the physician cannot remove that swelling suddenly; but he tells him, perhaps, how it can be removed: by his persevering in a certain course of practice. Precisely the same relation exists between the diseased sinner and his spiritual physician, and precisely the same kind of advice ought to be given to him. But depend upon it, if this spiritual physician tells him he can cure him instantly, can change his bloated, diseased character suddenly to a pure and healthy one, I say if he tells him any such thing as this, he is a spiritual quack.

The bad effect of telling the reformed sinner that he is entirely changed, is, that it leads him to think there is nothing for him to do but to live right along, a regular Christian. It puts him off his guard against the old enemy, generally called Devil, but which may be to a great extent, vicious brain. And then, if the old devil, or this old vicious brain gets the start of the will at any time, and the poor fellow happens to say a bad word, what an awful fuss is kicked-up. He is hauled over the coals at once; is disgraced, excommunicated, turned adrift, and in the language of the

Scripture, takes to himself seven other devils worse than the first. But tell the penitent, who has resolved to do better, that he cannot be changed at once, that he has got to acquire a better character by long and patient practice, the same way that he acquired the bad one, and with this additional obstacle, that his will has got to contend constantly against the bad influence of the old brain, as long as any of it remains, that the old character belongs to. And then, if he does happen to say a bad word once in a while unintentionally, don't run and tell the schoolmaster, and have him turned out of school; but encourage him to do better in future. If this plan was carried out, and sinners converted naturally and permanently, there would not be a tenth part of the backsliding that there is.

I could dwell much longer on the brain and its mind, but I must devote a little time to the other parts of the nervous system. Going directly from the brain to be distributed to the different parts of the face, eyes, ears, mouth and throat, are nine different nerves; some of these nerves go to the muscles of the face; some have feeling; one of them takes cognizance of sound—it goes to the internal ear; it is the only nerve of the body with which we can hear; it is called the Auditory nerve. Another takes notice or cognizance of light and colors; it goes to the eye, and is called the Optic nerve. The Olfactory or smelling nerve, goes to be distributed over the lining membrane of the nose; this takes notice or cognizance of the different odors that different objects have. Another nerve is distributed over the surface of the tongue and inner structure of the mouth; it takes notice or cognizance of the taste of substances, it is called the Gustatory

nerve. No one of these nerves can take cognizance of any quality of an object but one. The Auditory nerve, only of sound; the Optic, only of sight; the Olfactory, only of smell; the Gustatory, only of taste. Why this is so, we cannot tell; it is undoubtedly owing to some peculiarity of the structure of the nerve, or that portion of the brain from which the nerve starts. What that peculiarity of structure is, that enables one-nerve to notice sound, and another light, and another taste, we have not yet ascertained. At some future time we shall undoubtedly progress far enough in physiology, to tell. Many things that appeared fully as mysterious, five hundred years ago, are now well understood. Some of the nerves going directly from the brain have control over the muscles of the face, the eyes, the mouth, the lower jaw, the tongue, and the muscles of the throat. Some of them also are ordinary sensitive nerves, which produce pain when they are injured, acting as sentinels to let the brain know when the part is being injured. The nerves of special sense, the Auditory, the Optic, the Gustatory, and the Olfactory have no other sensation except by their connection with the nerves of ordinary sensation. The connection of the Auditory nerve with nerves of ordinary sensation accounts for the pain it produces in some persons to hear a saw filed. The connection of the optic nerve with nerves of ordinary sensation accounts for a strong light producing pain in the eye. This is a wise provision to prevent the nerves of special sense from being injured by improper use.

We leave the brain now, and the nerves going directly from it, and follow the great Spinal nerve out from the skull, through the large hole at the base of the skull, called the Foramen Magnum. This spinal

nerve or Spinal Marrow, as it is generally called, is a bundle of minute nervous fibres coming from every part of the body, and going to unite with the brain. Each one of these little fibres has its commencement in some part of the body, and its termination in the brain, constituting a complete telegraph, extending from every part of the body to the brain, the centre of the nervous system, by which sensation, or the condition in which each part of the body is in, is communicated to the brain, and by which, the orders of the brain are carried back to the part. For carrying on this correspondence between the brain and the different parts of the body, two sets of nerves are employed. One set conveys to the brain a knowledge of the condition that the part is in, from which the nerve starts. If the part is being injured, it conveys a painful sensation to the brain; if the part is experiencing a pleasant sensation, it conveys a pleasurable sensation to the brain. If nothing unusual is going on in the part, the nerve remains quiet, and does not make a report to the brain. The other set of nerves convey the orders of the brain to the muscles of the part to contract or relax, in order to produce the different motions of the part. These two different kinds of nerves go together bound up in the same sheath, to be distributed to the same part. The nerves go out from the spinal cord in pairs; one from each side of the cord; they go out from between the bones of the spine or back-bone, between each of which, at the sides, is a hole formed for this express purpose. There are thirty-one pairs of the spinal nerves, twenty-five pairs going out from between the bones of the spine, and six pairs going out from the sides of the sacrum, or continuation of the back-bone.

Each of these nerves starts out from the spinal marrow by two roots; one root coming out from the front part of the spinal cord, which is the nerve that presides over or carries the order to the muscles to contract or relax, another root starts from the back part of the spinal cord; this presides over the feeling or sensation of a part, and carries an account of the condition of the part to the brain. This root has a little enlargement or knot, called a Ganglion, just after it leaves the spinal cord. Now these two roots unite before they go out of the back-bone, forming one nerve, in which shape it goes to be distributed to that part of the body to which it belongs.

If you cut off the root of the nerve that comes from the front part of the spinal cord, you destroy the motion of the part to which the nerve goes, but the sensation or feeling of the part remains. If you cut off the root that comes from the back part of the spinal cord and let the front root remain, you destroy the feeling of the part, but the motion remains. If you cut off both roots, you destroy both the motion and feeling of the part; and generally whenever you cut off a nerve, after it leaves the spinal cord, you destroy the feeling and motion of the part to which it goes; or you produce a paralysis of the part. Sometimes paralysis is produced from some difficulty in the brain; in this case, the paralysis extends to one half of the entire body, and this half is the one opposite to the half of the brain that is affected, because the nerves going from the body cross after they enter the skull — the nerves from the right side of the body going to the left half of the brain, and the nerves from the left side of the body going to the right half of the brain.

If the spinal cord is injured in any way, all the

nerves coming out from below the injury, are affected. If the spinal cord is cut off or destroyed, all the parts that are supplied with nerves coming out from below where the spinal cord is destroyed, are paralyzed—their motion and sensation are destroyed.

There is one more set of nerves to be spoken of, and we are through with the nervous system. These are the involuntary nerves, over which the will has no control. This system of nerves is called the Involuntary or Sympathetic system of nerves, and is supposed to have its centre in a collection of nervous knots or ganglia situated behind the stomach, between that and the backbone. This system of nerves extends itself over the whole body, forming in its course little knots or ganglia, from which, as from independent centres, this peculiar nervous influence seems to go to the parts to which its branches are distributed. This system of nerves presides over those operations of the body over which the mind should have no control; as over the nutrition or growth of every organ, over the heart, bowels, lungs, liver, kidneys, spleen, stomach, and over every part, in a word, which is not governed by the will.

If the mind or brain had control over these functions, our bodies would continually be getting out of order. Our brain having so many things to attend to, would forget to attend to the nutrition of the body, to the circulation of the blood, and to the action of the other vital organs.

This system of nerves seems to have no rest; the functions over which they preside are continually in operation. Nutrition, breathing, the circulation of the blood, and the action of the different glands of the body are continually going on, while we are asleep and while we are awake. These sympathetic nerves

never get tired as the voluntary nerves do. This involuntary system of nerves is connected by small branches with the voluntary system of nerves, which causes the two systems to sympathize with one another slightly.

Although the two systems are entirely distinct in their individual action, yet where they join, as they do in some parts of the body, it makes the part to which these mixed nerves go, affected both by the involuntary and by the voluntary system of nerves. The operations of the stomach and the heart are affected by the mind slightly, because the brain sends a small nerve that unites with the sympathetic nerve supplying them. This nerve is so small, however, that the mind can have but a small influence over these parts, compared to the influence that the sympathetic nerves have. This influence of the mind is noticed in the effect that different emotions have on digestion and the action of the heart. Tell a person some very bad news just after he sits down to eat, and however hungry he may be, it will take away his appetite. Fright will cause the heart to beat more rapidly.

LECTURE VII.

THE CIRCULATORY SYSTEM AND THE LUNGS.

(THE BLOOD, HEART, AND BLOODVESSELS.)

You all know what the Blood is. You have seen it often. It is that red fluid contained in the veins and arteries. If blood is permitted to stand it separates into two parts: a thick, clotted portion called Crassamentum, and a thin portion called Serum. What it is that keeps these portions mixed intimately together, when in the living body, and what causes them to separate, when drawn from the body, we cannot tell. It is not the heat of the body, for you can keep the drawn blood at the same temperature that it was before it is drawn, and it will thicken just about as quick. It is not the motion that the blood has in the body, for you can keep it warm and keep it in constant motion, but it will still form into clots, its thin part separating from the thick part.

The blood is principally formed from the food and drink we take. A portion of it is formed from the old parts of the system that are taken up by a system of vessels called Absorbents. The blood contains a variety of constituents for the nourishment and formation of every structure of the body. It contains the nourishment for the growth of the muscles, the bones, the skin, the hair, the ligaments, and every other part of the body. The blood penetrates every part of the

system except the hair, the nails, the cuticle, and the enamel of the teeth. These grow from underneath. What is it that circulates this blood through the system? The heart and bloodvessels. The heart is the principal moving power. The bloodvessels assist in the circulation of the blood by their elasticity; and the minutest bloodvessels, into which the arteries terminate, and from which the veins commence, which are called Capillaries, assist the circulation of the blood by a power called *capillary attraction.*

To commence, then, with the Heart. The heart is a muscular body; the muscles so arranged, as by their contraction, to lessen the size of the cavity that they surround. The heart is divided into four apartments or cavities. The two at the upper part of the heart are called Auricles; the muscles that surround them are thin, their office being only to force the blood from their cavities into the other cavities or ventricles of the heart. The two other cavities of the heart are called the Ventricles: they occupy the lower portion of the heart; their walls or muscles that surround them are much thicker than the walls of the auricles: for the muscle of the ventricles, by its contraction, forces the blood through the lungs and through the whole system. The muscle of the ventricle, on the right side of the heart, by its contraction, forces the blood through the lungs. The muscle of the ventricle, on the left side of the heart, forces the blood through the general system.

The heart is situated in the left breast, between the right and left lung, just above the diaphragm or midriff, (the membrane that separates the chest from the abdomen). The heart is inclosed by a serous membrane that secretes a thin fluid that is spread out over

the heart, so that its motions may be free, and without friction. A similar membrane and a similar fluid surround the brain. Now the philosophy of the action of the heart is this: the blood from the veins of the general system is poured into the right auricle; the right auricle contracts and forces it into the right ventricle. The right ventricle contracts and forces it through the lungs. The blood returning from the lungs, having been changed while passing through the lungs, from venous into arterial blood, is received into the left auricle: the left auricle contracting, forces the blood into the left ventricle. The left ventricle contracting, forces the blood through the whole body. But, you ask, What prevents the blood going back into the auricles, when the ventricles contract? There are placed at the openings, going from the auricles to the ventricles, little valves that permit the blood to go from the auricles to the ventricles, but prevent it going back into the auricle when the ventricle contracts. Likewise, there are valves placed at the commencement of the great vessel that carries the blood from the right side of the heart to the lungs, that permit the blood to go outward to the lungs, but prevent it returning to the heart. The same kind of valves are at the commencement of the great vessel carrying the blood to the general system, permitting the blood to go out but preventing it returning to the heart.

I will now commence and give a connected account of the circulation of the blood, and of its physiology or use to the general system. We will commence with the left ventricle, supposing it to be full of arterial blood, containing the healthy aliments for the support and growth of every structure of the body. The left ventricle contracts and sends the blood through

the arteries until, by their continued subdivisions, they merge into capillaries, the minutest divisions of the bloodvessels, the little hair-like vessels that connect the terminations of the arteries with the commencement of the veins. Here in these minute vessels, too small to be seen by the naked eye, the nutritive properties of the blood become separated from it, and go to the nourishment and growth of the different structures of the body. The blood becomes changed in passing through these minute vessels, its nutritive parts being taken from it, and thus changing it from arterial to venous blood.

The minute veins that commence at the termination of the capillaries, unite with one another and form larger veins; these unite together until all the veins of the lower part of the body unite together into one vein, called the Vena Cava Ascendens, which empties into the right auricle; and all the veins of the upper part of the body unite into one vessel, called the Vena Cava Descendens, which also empties into the right auricle. Here then, in the right auricle, is collected all the returned, impure venous blood of the whole system. This must be purified before it can nourish or sustain the system; how is this purification to take place? Why, in the same way that you purify your bed-clothes—by airing it. The blood must be aired, must come in contact with the atmospheric air: for this purpose, the lungs are made.

The lungs or lights, as they are generally called, are composed of an infinite number of little air cells, each cell connected with a minute tube, which tube is connected with a larger tube, and that with a still larger one, called the Bronchia, until they all unite into one large tube, called the Trachea, or windpipe. In

breathing, the air passes through the windpipe, and along its divisions or bronchia, until it finally reaches the air cells. Now, each of these air cells is surrounded with a tender vascular membrane, in which the bloodvessels coming from the right side of the heart terminate. The terminations of these bloodvessels are minute capillaries of the same size as the capillaries through the other parts of the body, the connecting link between the arteries and veins. When the venous or impure blood which has been returned from every part of the body to the right side of the heart, is diffused through this vascular membrane surrounding the air cells, it comes in contact with the air that is drawn into the air cells in breathing. And here the blood becomes changed, by its contact with the air, from impure, dark venous blood, into pure, bright-red arterial blood. When it becomes so changed, by the passing off of the carbonic acid and other impurities of the blood and the absorption of oxygen from the air, the blood passes into the minute commencements of the bloodvessels that carry this purified blood back to the heart; but this pure blood goes to the left side of the heart, entering into the left auricle; the left auricle contracting, forces it into the left ventricle, and here is where we started with the pure blood.

This is the manner in which the blood circulates through the system, being changed twice in its course; once in the minute capillaries of the general system, where its nutritive properties are taken from it, and once in the lungs, where its life-giving properties are returned to it again. But how is this loss made up, that the blood is undergoing continually, by supplying nutriment to the different parts of the body, and in

throwing off the discharges from the lungs, skin, and other evacuants? The blood is replenished from two sources, from the food and drink, and from the continual taking up of the old, worn-out portions of the system, by an apparatus called the Absorbent System. When the food is taken into the stomach, it becomes dissolved there, and changed into a homogeneous substance, called Chyme; it then passes into the first bowel, where it becomes mixed with the bile and pancreatic fluid and changed into Chyle, and is taken up by a set of minute vessels called Chyliferous vessels, whose mouths open into the first bowel; this Chyle is collected in a little sack, called the Receptaculum Chyli; from this, it is carried through a tube, called the Thoracic Duct, up through the back part of the chest, and emptied into the Subclavian vein; it goes along this vein with its venous blood into the right side of the heart; from thence to the lungs, to be mixed with the air, where it receives oxygen, and is converted into pure arterial blood. The other source from which the system is replenished, is from the old, worn-out portions of the system that are continually being taken up by the absorbent vessels. Along these vessels are little glands, called Lymphatic glands, through which the blood goes to undergo some change that we do not exactly understand. These little absorbent vessels keep uniting and forming larger vessels, until a part of them pour their contents into the Receptaculum Chyli, and thus pass into the Subclavian vein; and another part of them unite and pour their contents directly into the Subclavian vein. We see by this arrangement, that Nature is a great economist, using up all the old materials to form new ones with. It is a good example set before us to be

economical, and use up all the pieces and scraps and old, worn-out articles for some purpose or other. The arteries assist the circulation of the blood by an elasticity that their coats possess. When the left side of the heart contracts, it sends a volume of blood through the arteries, and thus expands them; immediately the elastic coat of the artery contracts, and keeps the blood going on, until another volume of blood is forced in by another contraction of the heart.

But what is it that carries the blood along the veins? Probably the force from behind. The arteries, acting through the capillaries, may have some effect, and then the suction of the heart, when the right auricle opens, may have an influence. The veins coming from the lower part of the body, as well as the large lymphatic vessels, have valves all along their inner surface, which prevent the blood going back but let it go upward toward the heart. The openings of the small veins of the brain into the large ones are peculiar; they enter at an angle against the current of the blood, so that they form a valve at their openings, which prevents congestion in the substance of the brain taking place so readily in case of a stoppage of the blood in the great veins of the brain or neck.

The Lungs, beside changing the blood so as to prepare it for the nutrition of the body, are the seat of another very important function of the animal economy — that of the production of animal heat. The union of the oxygen of the air with the carbon and hydrogen of the blood, forming carbonic acid and water, both of which pass out from the lungs by the breath, is a chemical operation which produces heat whenever the operation is performed. It is the same chemical operation that produces heat in the burning

of wood in a stove or fireplace, that takes place in the lungs for the production of heat. All the difference is, that the combustion or burning does not go on so rapidly in the lungs as in a stove; and a draught of air is just as necessary for the burning to go on in the lungs as in the stove. This is proved by the well established fact, that a person cannot live where a fire will not burn. Hence the propriety of letting a burning candle down into a well or deep hole, where carbonic acid is apt to settle (it being heavier than the air), before one descends. If the candle continues to burn, the person is safe in going down; but if the candle goes out, the person's lamp of life will go out there just as quick.

The food and the old worn-out particles of the system furnish the fuel to be burned in the lungs. In this burning operation in the lungs, Nature accomplishes two objects at the same time — kills two birds with one stone. The very impurities that she sends off from the lungs, to render the blood proper to be circulated through the system for its nourishment, she burns there by the draught of air drawn into the lungs in breathing. She acts as economically in this respect as the man who keeps up the fires of a steam sawmill by the sawdust and slabs.

This power of generating heat, that the lungs have, enables the body to exist in very cold situations, provided sufficient fuel, or blood, is supplied. This shows the necessity of eating more nutritive food in cold climates or in the winter, than in warm climates or in the summer. The inhabitants of northern regions, where they have almost constant winter, understand this, living almost entirely on oils and fat meat in order to supply sufficient fuel to keep up the heat

Such strong food would soon destroy them in a warm climate. It would be hard to keep up sufficient animal heat with vegetable food in those cold climates.

Any exercise that increases the circulation of the blood and hurries the breathing, increases the production of animal heat, in the same way that an increase of the draught of wind in a stove will increase its heat; but both, under such circumstances, require more fuel. It is on this principle, that one warms himself by active exercise.

When treating of the skin, we showed you how the body is prevented from getting too hot; we have now shown you how it is prevented from getting too cold. By means of these two functions of perspiration and respiration, the temperature of the human body is kept the same under all circumstances.

The necessity of breathing a pure air with sufficient oxygen to produce this change of the blood and to keep up the necessary combustion, appears evident at once. Our sitting, and eating, and above all, our sleeping rooms should be well ventilated, so that one coming into them from the open air, does not experience a closeness or oppression of the atmosphere. Our schoolhouses, and churches, and public conveyances should all be thoroughly ventilated. No practice will depress the nervous system sooner, than for one to be obliged to breathe the exhausted air of a public assembly-room tainted perhaps with the breaths of a hundred diseased lungs.

There is much more I would like to say on this subject, but a want of time will prevent me. If you will bear in mind the general principles I have laid down, they will guide you correctly in this matter.

The heart and lungs are subject to disease, as is every other structure of the human body, and I shall merely have time to glance at them.

The walls of the heart sometimes grow too thick, and act too powerfully. The serous membrane, surrounding the heart, sometimes pours out too much fluid, impeding the action of the heart. More commonly, the valves of the heart become partially changed into a bony substance, allowing the blood to flow back into the large vessels when the heart contracts. All diseases of the heart are very serious, keeping the person, so afflicted, in danger of instant death at any time.

The serous membrane surrounding the lungs, called the Pleura, is subject to inflammation producing pleurisy; a very common disease in this climate. When the lining membrane of the air tubes of the lungs or bronchia are inflamed, it is called Bronchitis. When the substance of the lungs themselves, the part that forms the air cells, is inflamed, it is called Pneumonia or Inflammation of the lungs. This inflammation is of two kinds — the common inflammation of the lungs without other complication, as in the lung fever of our climate, and that peculiar inflammation that exists in what is commonly called Consumption. The first kind of inflammation is produced by a stoppage of blood in the lungs—the blood becoming clotted or thickened there, changing the porous substance of the lungs into a more compact substance resembling very much the substance of the liver. In order to remove this, Nature goes to work and excites inflammation, and turns the hardened lung into matter which is raised and spit out in coughing. But in consumptive inflam-

mation of the lungs, the seeds of the disease exist there generally from birth, being transmitted from parent to child. Whenever favorable circumstances occur for inflammation to commence in these little seeds of consumption, called Tubercles, they commence turning into matter, the inflammation extending from one tubercle to another, eventually involving the whole lungs — the tubercles being scattered all through the lungs before the change or ulceration commences. These tubercles or seeds can be seen in a consumptive lung very plainly, resembling a millet seed. A person may live a long life with these seeds of consumption in his lungs, and finally die with some other disease. But if the ulceration once commences in these tubercles, and they begin to change into matter, it is almost certain to go on until the lungs are entirely destroyed.

The inference is that if a person has reason to believe that his lungs contain these tubercles or seeds of consumption (which can generally be ascertained by any intelligent physician), it stands him in hand to take those precautions necessary to prevent a development of the disease, to prevent ulceration commencing in these tubercles. This is best done by a proper and temperate way of living, by exercise in the open air, by an avoidance of exposure to sudden changes of temperature, and by a change of residence from a cold, variable climate to a warm and regular one. Place no reliance in the nostrums you see advertised for the cure of consumption; they are infamous lies. Believe not the quack who tells you he can cure the consumption, for he is either ignorant of the disease or a willful liar.

DIVISION OF THE BODY INTO TWO APARTMENTS.

The trunk of the body is divided into two apartments by the Diaphragm (Midriff). In the upper apartment, called the Chest, are contained the lungs, and heart, and the Pleuræ which surround them. In the lower apartment, called the Abdomen, are contained the stomach, liver, intestines, kidneys, spleen, pancreas, and bladder.

The structure of the diaphragm is partly muscular and partly tendinous. When its muscular portion contracts, the diaphragm stretches across the body in a straight plain, enlarging the chest downwards; this occurs in inspiration, or drawing in the breath. When the diaphragm relaxes it assumes a convex shape above and a concave below, diminishing the cavity of the chest upward; this occurs in expiration, or forcing out the breath. Now the philosophy of breathing is this. In inspiration the ribs are raised by a set of muscles attached to them for this express purpose, thus enlarging the chest laterally; the diaphragm contracts, thus enlarging the chest downward, as before said; this enlargement of the cavity of the chest laterally and vertically produces a vacuum in the chest, and the air rushes in to fill it. It is the pressure of the atmosphere outside that forces it into the lungs as fast as the vacuum is produced there. The air, in like manner, will rush into any cavity whose size you enlarge suddenly.

Expiration, or the forcing of the air out of the lungs, is produced by the ribs being drawn down by means of muscles, and by the diaphragm being forced up by the muscles over the abdomen contracting and pressing the contents of the abdomen up against the diaphragm.

The principle of the action of the lungs is illustrated by the blacksmith's bellows if the clapper at the bottom be stopped. When he wishes to fill his bellows with air, he lets the lower board fall like the diaphragm, and the air rushes in to fill the vacuum, through the nose. When he wishes to force the air out, he draws the lower board or diaphragm, up, and thus forces it out. The blacksmith's bellows using no ribs to expand the lungs laterally, like a fashionable chest, makes the comparison more striking. The blacksmith's bellows does its breathing entirely by the under board, or diaphragm; in the same way that a person breathes, who has the breast bound up so that it cannot be expanded laterally. Such persons breathe entirely by the diaphragm and the muscles of the abdomen or belly.

LECTURE VIII.

THE ABDOMINAL ORGANS.

The contents of the Abdomen are the Stomach, Bowels, Liver, Spleen, Kidneys, Pancreas, Bladder, and a Serous membrane that covers all these organs; beside, there are numerous Lymphatic glands, and the great centres of the Sympathetic nervous system. The stomach is situated in the upper part of the abdomen. It is composed of three coats, as are also the bowels, an external or serous coat, called the Peritoneum, intended to hold it in its place, and to enable its motions to be easy and free from friction. This is the use of the serous membranes that surround all the vital organs of the body. The middle or muscular coat of the stomach is a layer of muscular fasciculi surrounding the stomach in different directions, by whose contraction the motions of the stomach are produced. It is the contraction of these muscular fasciculi, when they contract in the natural way, that forces the food, after it has become dissolved in the stomach, into the first bowel. But when these muscular fasciculi contract in an inverted or unnatural way, they force the contents of the stomach in another direction, that is, upward, producing vomiting. The inner coat of the stomach is a continuation of the mucous membrane or internal skin that lines the mouth and throat, the air tubes, and every other internal passage. In the stomach it is found in the ridges and folds to admit of expansion

as the stomach becomes filled. Opening through this mucous membrane are the mouths of numerous glands that secrete and pour out into the stomach a fluid called the Gastric juice—the object of which is to dissolve the food and convert it into a thin fluid called chyme. After the food has been received into the stomach, through the Esophagus, and its opening into the upper part of the stomach called the Cardiac orifice, and has become dissolved by this gastric juice and been converted into chyme, it is forced out of the stomach through the Pyloric orifice, by the contraction of the stomach into the first bowel called the Duodenum. Here the chyme becomes mixed with the secretions from the liver and the pancreas, being changed into chyle, and its nutritive portions become absorbed or taken up by a set of vessels that open into the bowels, called the Chyliferous vessels. These little vessels carry the chyle and empty it into a sack called the Receptaculum Chyli, where the chyle also becomes mixed with the old, worn-out portions of the lower part of the body that are taken up by the lymphatics and carried and emptied into this receptacle; from this, the chyle is carried up through the back part of the chest, by the thoracic duct and emptied into the right subclavian vein, which mixes it with the venous blood and carries it to the right side of the heart, whose contraction forces it through the lungs in order that it may be converted into perfect blood for the nourishment of the system.

The Duodenum or first portion of the small bowels, is called thus from its length, being about twelve fingers' breadth. The next portion of the small bowels is called the Jejunum, meaning empty, because it is most always found empty; it is much longer than the

duodenum. The last portion of the small bowels is called the Ileum, being the longest portion; this joins with the Cœcum, the first portion of the large bowels. The cœcum, which is very short, joins with the Colon or second portion of the large bowels. The Colon is much the largest of the large bowels. It makes a curve surrounding the small bowels and terminates in the Rectum, the last portion of the large bowels.

The bowels have three coats the same as the stomach. The middle or muscular coat is formed of two layers of muscular fasciculi; one layer running lengthwise of the bowels; another layer goes around the bowels. By the contractions of these two muscular layers of the bowels, the motions of the bowels are produced. Irritating substances taken into the bowels stimulate these muscular layers to contract more forcibly. This is the way cathartics affect the bowels: they stimulate these muscular layers to increased action.

THE GLANDULAR SYSTEM.

A Gland is a body of a peculiar globular structure, whose function is to separate some particular fluid from the blood. The Liver is a gland, whose function is to separate bile from the blood. When speaking of the skin I showed you the oil glands, whose function is to pour out a delicate oil on the skin and hair. In the mouth are glands that separate the juices of the mouth, called Saliva, from the blood. These are the Parotid, Sublingual, and Submaxillary. One of these, the parotid gland, situated above the angle of the jaw, is the seat of the disease called "mumps." The glands of the mouth are stimulated to increased action by substances taken into the mouth, either for

food or for mere excitement, as in the use of tobacco. It was undoubtedly intended that the salivary glands should furnish sufficient fluid to mix our food with during mastication or chewing, so that there should be no necessity of using drink while eating. We see the lower animals follow this rule; they do not drink while eating. It would undoubtedly conduce to our health if we should follow their example.

In salivation from the use of mercury, these glands become inordinately excited. Above the eye is a gland that separates the tears from the blood. It is called the Lachrymal gland. All through the bowels are little glands that separate fluids from the blood that are poured into the bowels. The kidneys are glands secreting urine. The secretion of the liver or the bile, as it is separated from the blood (which is abundantly sent through the liver for this purpose), is carried along little tubes which empty into larger ones until it is finally collected in the gall-bladder. The bile is carried from the gall-bladder by a little tube, called the Gall-duct, which empties it into the first portion of the small bowel.

The principal use of the bile is probably to act as a cathartic to stimulate the muscles of the bowels to contract, and thus carry off the indigestible portion of the food. It is Nature's cathartic, much better than any "Sovereign balm," or "Sovereign poplar," or "Sovereign butternut" pill. And our object should be, when the liver becomes torpid, and consequently the bowels become inactive, to restore the action of the liver, thus giving the bowels their natural purgative. When the liver is inactive the bile remains in the blood, and is deposited in every part of the system,

giving a yellow tinge to the different structures and secretions.

That the bile is intended for a natural purgative is proved by the way its duct empties into the bowels, forming a valve that prevents the bile being poured out when the first bowel is full; but as soon as the chyliferous vessels have taken up the nutritive portion of the contents of the bowel, and the bowel becomes partially empty, the valve opens and the bile is poured into the bowel and stimulates it to carry off the indigestible portion of the food. You see that there cannot be bile in the stomach under ordinary circum stances, because it is emptied not into the stomach, but into the first bowel. The reason that we vomit bile sometimes is, that by the inverted muscular contractions the bile is forced up into the stomach from the bowel, and the stomach then forces it out at the mouth.

Sometimes there are little, hard bodies formed in the gall-bladder, called Gall-stones, that get down in the duct going from the gall-bladder to the bowel, and stop it up; if it remains there and is unable to pass, it will finally cause the death of the individual.

THE PANCREAS.

The Pancreas is a glandular body lying behind the stomach; it secretes a fluid which is emptied into the duodenum by means of a duct. It performs some office in digestion.

THE SPLEEN.

There is another body in the abdomen, situated in the left side immediately under the ribs, called the Spleen; the precise use of which we do not fully

know, unless it be a reservoir for the blood before passing through the liver. It does not secrete any fluid, nor does it seem to change the blood that passes through it in any way. It becomes congested with blood from any cause that sends the blood from the surface and extremities to the internal organs, as for instance, in a chill of the ague. By being frequently congested in this disease, it eventually becomes permanently enlarged, forming what is called the "Ague Cake."

In reference to the hygiene of the organs contained in the abdomen; that is, in reference to the keeping those organs in a state of health, I would refer you to the remarks made in reference to the hygiene of the nervous system, inasmuch as they are applicable not only to the hygiene of the nervous system, but to the hygiene of the digestive system and to every other system of the body. In the first place, you want to select the proper kind of food. It should be of a light, unstimulating character, and bulky rather than concentrated. The major part of our food should be vegetable; in the summer time perhaps it would be better to be entirely vegetable. The proportion of meat diet should be in proportion to the coldness of the atmosphere. In high northern latitudes an entire animal diet seems necessary in order to afford sufficient fuel to keep up the heat of the body; but for temperate or torrid climates a vegetable diet is undoubtedly the best.

Perhaps there is not a healthier or stronger nation of people than the Irish. They may be said to be entirely vegetable eaters. And I think I can make this assertion with truth, that wherever you find, in our own country, a purely vegetable-eater, other

things being the same, you will find the healthiest and strongest individual.

The medical preceptor that I studied with, Dr. Mussey, of Cincinnati, is a vegetarian; he uses no animal food at all, and I challenge the State to produce a man of his age (near fourscore years, I believe) who is stronger, physically or mentally, than he. When I was with him, he had a boy about fourteen years old who never tasted of meat; he was a perfect specimen of health and physical development. Dr. Mussey has a large family, and sickness is a thing unknown in it. He is strictly temperate in every other respect, uses no tobacco or spirits in any form, and uses no drink but water and milk. He uses his vegetables in an unmixed, natural condition, altering them in no way but by cooking. His bread is made from unbolted flour.

The reason that I introduce this individual as an illustration, is, that I consider him as near a perfect example of propriety in living as we find now-a-days. He is deserving of no great credit for this. He merely lives as nature designed he should. He lives as men did in the first periods of the world, and he gets his own reward for it, as he goes along, in a constant enjoyment of good health. He does not lose an hour in a year from ill health; he is enabled to do twice as much, old as he is, as other physicians who live in an unnatural, modern manner.

Use then principally a vegetable diet. By vegetables, I mean grains, such as wheat, corn, rye, rice, buckwheat, and roots, such as potatoes, onions, beets, cabbages, and the like, and all kinds of healthful fruits. Let your grains be ground and not bolted, for your bread. The hulls of grain are just as necessary

for your digestion as the hulls of oats are for the digestion of a horse. Nature has mixed these things in exactly the right proportion for use, and we are interfering with her when we separate them and use only the most nutritive portions of them. The roots, as a general thing, require to be cooked. Ripe fruits are better to be eaten without being cooked.

The food should be well chewed and mixed with saliva; as little drink as possible should be used while eating. The salivary glands will afford fluid enough, unless we keep them at work too hard between meals, by tobacco or chewing gum, or by smoking. After the food is swallowed (which should not be in so great quantity as to produce uneasiness), we should rest, or, at least, not work very hard for an hour or so, in order that the vital energies may go to the stomach and supply it with sufficient power to digest the food. Very active labor, either of the body or mind, immediately after a meal, draws too much of the vital energies away from the stomach, and digestion does not go on. A gentleman fed two hounds and set one of them to running immediately after the meal; the other he let rest; at the end of two hours, he killed them both. The food in the stomach of the one that ran was in almost the same condition as when he swallowed it; while the food in the stomach of the hound that rested, was entirely dissolved and digested. An intelligent teamster always lets his team rest after eating; they will accomplish more work.

Want of time prevents me from dwelling on this subject as long as I would wish to. There are many common diseases of the digestive organs, such as dyspepsia, cardialgia, colic and the different varieties of what are called Bowel Complaints and Cholera, that I

would like to speak of, inasmuch as they are common diseases among us. But I find that if I should commence treating of the different diseased conditions of the body, it would require me to extend my lectures to two or three times the number that I had intended. If I have leisure, at some future time, I may give you a course of lectures on the human system, as affected by disease; and tell you the simplest methods of correcting those diseased conditions, and bringing them back to a healthy condition.

There is one other set of organs that I have not yet spoken of as a system, and which are considered of some importance to us all; these are the Vocal organs. These form the apparatus or instrument with which we talk, and sing, and make all the other sounds of the voice. The instrument for the production of the voice has been compared to almost every musical instrument—to the clarionet, flute, violin and drum. In order to be a little different from any of the rest, I will compare it to a bagpipe, the bellows of which, are the lungs; the leather tube, the trachea or windpipe, and the wooden finger-pipe, the larynx. The sounds of the voice are produced by the forcing of the air through the windpipe and larynx by the lungs. In the upper part of the larynx is a little box made of cartilage or gristle; you can feel it with your fingers; it is commonly called Adam's Apple; physicians call it the Larynx. This little box is composed of five gristles or cartilages. The Thyroid is the largest one, called thus from its supposed resemblance to a shield; it is the one you feel in the prominence of your neck. The Cricoid is immediately below the Thyroid, called thus, from its supposed resemblance to a ring. The Cricoid joins the Thyroid and the upper part of the

windpipe, by means of ligaments. To the Cricoid are attached two little triangular-shaped cartilages, called the Arytenoid Cartilages; these are movable. Shutting over the top of the larynx like a clapper in a pump, is a cartilage, called the Epiglottis. When we swallow our food or drink, it presses down this Epiglottis, so that the food is not able to go down into the windpipe, but passes over it and goes down the Esophagus or gullet into the stomach; for you are aware that the windpipe lies in front of the Esophagus, and our food passes over the upper opening of the windpipe and goes down behind it. In the middle of this gristly box are stretched across it, two little cords, called the Cordæ Vocales, covered with the mucous membrane that lines the air passages; these little cords are fastened close together to the front part of the inside of the Thyroid cartilage; passing across the box, one is fastened to each of the little Arytenoid cartilages, forming a narrow slit through which the air passes in breathing; this little slit is called the Glottis. Now to these Arytenoid cartilages are attached muscles, which, by their contractions or relaxations tighten or loosen these little vocal cords, or separate them from one another or bring them closer together. Above these two little cords, is an enlargement of the box on each side, called the Ventricles; just above the ventricles, another slit is formed by two folds of the mucous membrane being stretched across. Now by this simple little instrument, all the modulations of the voice are produced. By the vibrations of these little cords and the variations produced by these little cords being stretched tighter or looser, or by their being separated from each other, or by being brought closer together the sounds of the voice are produced. The

farther these cords are separated from each other, the coarser the voice. This is the reason the male voice is coarser than the female voice. In man this cartilaginous box is larger than in woman, of which any of you can be convinced, by comparing the prominence in the front part of a man's neck with that of a female's. The different noises made by different animals are all produced by some peculiarity in the structure of this little music box, the larynx. Many of the lower animals, particularly some of the singing-birds, have a much better music box than man; but they lack the brain to use it in the thousand different combinations that man does. This then is the instrument of the voice. To be sure, the voice is varied in its different combinations of sounds by the palate, the tongue and the nose. But the sound itself, and the different tones from high to low, and from low to high, are produced by the air passing through and causing these little vocal cords or fiddle-strings of the neck to vibrate; and if you destroy these little cords, your talking and singing is at an end. I am well aware that the tongue has monopolized all the honor and the dishonor attached to the voice, but it is unjust; the tongue has but very little to do with the production of the voice; a person can learn to talk almost as well without the tongue as with it, so that the very common command to "hold your tongue" does not amount to much after all, toward stopping your clack.

The scientific and proper way of requesting a person to stop talking, would be—please relax the vocal cords of your larynx, so that they may not vibrate by the current of air passing between them.

THE EAR.

The ear is constructed to make impressions on the Auditory nerve, by the vibrations of the air. All sound is produced by the vibration of air. The outer or cartilaginous portion is constructed so as to concentrate the vibrations of the air on the ear-drum. The ear-drum communicates the impression to a chain of delicate little bones that are connected, so that the last one presses on a fluid contained in a snail-shaped bone, called Cochlea. Now the auditory nerve is spread out on the lining of this cochlea, so that every vibration of the air is thus communicated to the auditory nerve, and the auditory nerve conveys the impression to the brain; this is the philosophy of hearing. The chamber inside the ear-drum communicates with the pharynx or back part of the mouth by a tube called the Eustachian tube. This tube acts like the hole in the side of a drum to let air in the chamber.

THE EYE.

The eye is composed of three coats or layers; the outer coat is composed of the Sclerotica and Cornea; the middle of the Choroid coat, the Iris and the Ciliary processes; the inner coat, of the Retina and Zonula Ciliaris. The outer coat is hard and resisting, to give shape to the eyeball. The front part, the Cornea, is transparent, and shaped like a watch-crystal; it is inserted into the Sclerotica in precisely the same manner that a watch-crystal is inserted in its rim. The next coat is the Choroid and Iris. The Choroid is a thin colored membrane, the outer side of a chocolate color; the inside of a deep black. The design of this dark color is to absorb the surplus rays of light, else the eye would be dazzled and confused by a strong

light. In Albinoes, this color is wanting, which renders them incapable of seeing except in a faint light. The Iris—meaning rainbow, is so called from its variety of colors in different individuals; it serves as a curtain to divide the front, from the back chamber of the eye. It has a round hole in the center, called the pupil, through which the rays of light pass; through which we see. The Iris is composed of two sets of muscular fibres; one set radiating from the centre to the circumference, by whose contraction the pupil is dilated, and another set of circular fibres by whose contraction the pupil is contracted. A strong light excites the circular fibres to contract, so that the pupil does not admit so much light. A weak light excites the radiating fibres to contract, so that more light may pass through the pupil. The Iris has also another thin layer behind the muscular layer, of a purple color, and called the Uvea. The third tunic of the eye is called the Retina; it is merely an expansion of the optic nerve, which enters into the ball of the eye from behind, and is spread over about three quarters of the inner and back part of the eye. The Retina takes cognizance of light and conveys the impression of the optic nerve to the brain. Behind the Iris, is a transparent, crystalline body, called the Lens, the use of which, is to concentrate the rays of light so as to form a picture of the object or objects viewed, on the retina. An impression of this picture is conveyed to the brain by the optic nerve. The anterior and posterior chambers of the eye are filled with a transparent fluid, called the Aqueous humor. Behind the lens, filling the main part of the cavity of the eyeball, is the vitreous humor. The eye is supplied with nerves and blood-vessels as other parts of the body.

QUESTIONS

TO

LECTURES ON ANATOMY, PHYSIOLOGY, AND HYGIENE.

LECTURE I.

WHAT is necessary for a right understanding of these Lectures? Is it necessary to tell of the utility of this subject? What is the body? Do we understand most all its Laws? Will we eventually be able to explain all its Laws?..........................11

What is said about the engineer? Why is the study of physiology of more importance than any other study? Why was it of less importance in earlier times? Is sickness necessary?...........12

Are wild animals sick? Why are domestic animals sick? Are there many persons in enlightened society that are perfectly healthy? Should we be healthy in old age? What is the word Physiology derived from?..13

What was its province in the early history of the natural sciences? What is its province now? What is an organized body? Give examples of organized and inorganized bodies.. 14

Give examples of plants nearly allied to inorganized bodies. Give examples of plants nearly allied to the animal kingdom. Of animals resembling plants. What animal products resemble seeds? 15

What is said about the scale of life? What stands at the top? What are mammalia? In what does man differ from the other mammalia? What comparisons are made between men and monkeys, and in what do they differ?.................................16

In studying physiology, what shall we find in reference to each organ? Give examples of herbivorous and carnivorous animals. What does this knowledge enable a skillful anatomist to do? What did Cuvier do?...17

What comparisons are made between men and penguins? What have some philosophers argued? Prove that man was designed to walk erect. 18

Compare the brain of man with other animals. In what is man inferior to other animals? In what is man superior to other animals? What does this superiority enable him to do? What would be man's condition without this superiority? 19

What of man's articulating powers? What of the shape of his head? Of his vision? Of his jaws and teeth? What were they designed for, and for what kind of food? 20

Races of Men. What characteristics distinguish the races? What are the causes of these characteristics? Name the different races. Describe the Caucasian race. Why is it called thus? What is said of the present inhabitants of the Caucasian mountains? 21

In what does this race hold the sway? What is indicated by the present mixing of races? What are the peculiarities of the Caucasian head, eyes, nose, complexion? Give a sample of the Caucasian race. Describe the Mongolian race, and give its history, and an account of some of the nations of this race. What of castes? ...22

What does the American race consist of? What are its marks and habits? What civilized nations has this race afforded? What characterizes the Ethiopian race? What is its position in relation to other races? What is the fifth division of the human family? Give an account of it. What is said about temperaments? 23

In describing man as an individual, what division is necessary? How are these parts connected? What is the object of these lectures? Illustrate by the engineer and steamboat? Do we know ourselves as we should? 24

How is it with the beaver? Is our power of acquiring knowledge limited? What part of man shall we begin at? What ideas should we get of men and women, judging from their external appearance? 25

How is the body divided by physiologists? What is the appearance of the body, viewing it as a whole? 26

What is the body of man furrowed over with? How does he differ from woman in this respect? In what does the female differ from the male? 27

Does occupation make a difference in this respect? 28

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What is the cause of grayness? What is said of grayness being produced suddenly? 41

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How do they grow, and what is their use? What are hang nails? Their treatment? What is said of the external covering of animals? Could man exist in a northern latitude without covering?.......43

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When there is a deficiency of the animal portion? Relate the incident from Lord Anson's voyage. In what other ways are bones diseased? What is the cause of bones being diseased? How do bones grow, and which part is formed first? Which portion of the bone predominates in childhood? In old age?.................47

How are bones divided? Give specimens of the different kinds of bones. What is the character of a long bone? Describe its different parts and their uses? The shaft, extremities, its hollow and marrow? Is there marrow in the bones of birds? Why are the long bones hollow? How are bones nourished?............48

different animals. What quadruped has no teeth, and why? What peculiarity is there about the elephant's teeth?................56

Can you tell the age of animals by the teeth? Of what is the spine composed? To what is the first or upper bone of the spine attached? The lower bone? What is contained in the hollow that passes through the spine? How is this cord made up? What hole is there between each of the bones of the spine? What comes out of these holes? How many pairs of these nerves are there?....57

What covers the articulating surfaces of each of the bones of the spine, and what is the use of this covering? Tell the number and peculiarities of the bones of the neck; of the back, and of the loins. Tell how the ribs are fastened to the spine. What is the shape of the spine, as a whole?......................................58

What causes produce curvatures of the spine? What is said about the attitudes of children in school?..........................59

What does the spine rest on? Describe the pelvis and its different bones. What does the pelvis rest on? How are the thigh-bones held in their sockets? Describe the thigh-bones, and tell how they are moved in different directions..............................60

Describe the bones of the leg, and tell how they are moved. Describe the patella, and tell its use. With what are the bones of the leg articulated above and below?..............................61

How is the back part of the foot formed? Describe the other bones of the foot, and the bones of the toes. What is the name of the bone of the arm, and how is it articulated with the scapula or shoulder-blade? Describe the bones of the fore-arm and their uses, and how they are articulated with other bones........62

How are the bones of the fore-arm fastened together? Describe the bones of the wrist, and hand, and fingers. How many ribs are there, and how are they divided? Describe them. What is said of the effects of tight-lacing?..................................63

Describe the shoulder-blade or scapula, the clavicle, the sternum, and the os Hyoides.......................................64–65

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LECTURE VI.

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What is the will? Illustrate the power it has over the body. Explain the manner in which the muscular and the voluntary systems are under its control. What practical point does this bring us to?..114

Illustrate how particular faculties become pets of the will; become more powerful than other faculties, so as to make a person skillful in their exercise. How is the formation of our character then under our own control?..............................115

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Can it be changed suddenly?..........................117, 118

What nerves go directly from the brain? Describe the auditory nerve and its functions; the optic nerve; the olfactory nerve; the gustatory..119

Does any one of these nerves of special sense take cognizance of more than one quality of an object? What is the probable cause of the nerves of special sense having this peculiar power? What do some other nerves, going directly from the brain, have control over? What are sensitive nerves, and their function? In what manner do the nerves of special sense convey a painful sensation? Illustrate. How is this a wise provision?..........................120

What is the spinal nerve and where is it situated? How is it composed? Where are the origin and termination of each nervous fiber? How are these nerves divided, and what is the function of each part? Illustrate. How many pairs of spinal nerves are there?...121

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nerve? What is this effect called? When paralysis is from difficulty in the brain, what is its feature?.......... 122

Explain this fact. If the spinal cord is injured, what nerves are affected? What if the spinal cord is destroyed? What is the involuntary system called? Where is its centre? Where does this system extend itself? What is found in the course of its nerves? What does each of these ganglia seem to be? What does this system of nerves preside over? Why should not this system of nerves be under the control of the will? Does this system of nerves have any rest? Illustrate..................................123

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LECTURE VII.

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LECTURE VIII.